The role and importance of veterinary laboratories in the prevention and control of infectious diseases of animals

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Summary
Veterinary laboratories which deal with infectious diseases form three groups according to the tasks for which they are responsible. The first group includes central or national veterinary laboratories, national or international reference laboratories, high-security laboratories, district, regional or state veterinary diagnostic laboratories. The major role of these laboratories is to assist national Veterinary Services in diagnosing infectious animal diseases. The second group comprises laboratories that produce veterinary diagnostic kits and those that produce veterinary vaccines. The third group is composed of veterinary research laboratories, which generally concentrate on basic research and do not contribute directly to the diagnosis and control of infectious animal diseases. The author describes the objectives of each of the three groups of laboratories.

Keywords

Introduction
Infectious diseases of animals play an important role in most sectors of veterinary medicine, particularly in the light of economic losses inflicted by such diseases. Direct losses result from death (usually of large numbers of animals) and from decreased production of food products, such as meat, milk and eggs. Indirect losses caused by infectious diseases include difficulties in the national and international movement of animals and animal products. Most infectious animal diseases are included in Lists A and B of the International Office of Epizooties (OIE) (4). Many infectious diseases are also zoonoses, which increases the significance of the disease.

Taking these facts into consideration, the principal objectives of national Veterinary Services are the organisation and implementation of effective methods to prevent and control infectious diseases. Modern laboratory facilities and a highly qualified staff of specialists are prerequisites to achieve success in these two fields of action (5).

Veterinary laboratories that participate in the prevention and control of infectious diseases fall into three groups, depending on the tasks for which they are responsible. Their role and importance are discussed below.

Group 1 laboratories
The following laboratories have a direct connection with the activities of national Veterinary Services: central or national veterinary laboratories, national and international reference laboratories, high-security laboratories, district, regional or state veterinary diagnostic laboratories and diagnostic laboratories in developing countries.

The principal role of these laboratories is to assist the veterinary officers of national Veterinary Services in diagnosing infectious animal diseases and confirming that an animal population is free from a defined infectious disease. Within a country or region, the status of freedom from an infectious disease which belongs to either OIE List A or List B is of prime importance in the international trade of animals and animal products.

Laboratories in this group are the key component in early recognition of an exotic or emerging disease that could destroy the local (or national) animal industry. Rapid diagnosis of a disease such as foot and mouth disease can save millions of dollars in terms of the eradication programme.
Group 2 laboratories

Group 2 laboratories, which are also linked to the activities of national Veterinary Services, manufacture diagnostic kits or vaccines.

Group 2 laboratories are instrumental in the control of infectious diseases. The vaccines for foot and mouth disease and classical swine fever (hog cholera) have allowed production of animals in endemic countries; the rinderpest vaccine has provided a method to eradicate that disease. The marker vaccines for Aujeszky's disease (pseudorabies) have provided an effective method for identifying the introduction of virulent virus into vaccinated animals and have also facilitated control programmes. There are numerous other examples of disease control through the development and production of vaccines.

The professional level of veterinary laboratories belonging to Groups 1 and 2 is, to a large extent, determined by the results of research in the field of microbiology, virology and biotechnology (including molecular biology and genetic engineering).

Group 3 laboratories

Research, mostly of a basic nature, is performed in veterinary research laboratories which form the third group of veterinary laboratories. The results obtained are characterised by new findings.

Research performed in laboratories of Groups 1 and 2 focuses mainly on the adaptation for laboratory practice of the results achieved by laboratories which belong to Group 3.

Scientists in veterinary research laboratories usually devote their entire time to scientific studies. Generally, these scientists do not co-operate directly with the national Veterinary Services, i.e., they do not collaborate directly in the diagnosis and control of animal infectious diseases. In addition, they are not engaged in the continuous education of veterinary practitioners.

The Group 3 laboratories provide the basic information that is used by the other two groups, now aided so effectively by the new molecular techniques that have allowed a better understanding of the pathogenesis of disease and of the mechanisms of pathogenicity of the agents that cause disease.

The objectives of those laboratories which belong to these groups is discussed in other papers in this volume. This paper is limited to a discussion on central or national veterinary laboratories (Group 1) and research laboratories (Group 3).
evaluate and validate the quality of biological preparations and diagnostic kits manufactured in production laboratories (Group 2 laboratories) and participate in the licensing procedures and registration of drugs, vaccines and diagnostic kits. Scientists from central or national veterinary laboratories may participate directly in the diagnosis and control of infectious diseases, especially in the case of emerging diseases. Certain central or national veterinary laboratories also produce vaccines and diagnostic kits for commercial purposes. Very often, national and international reference laboratories and/or high-security laboratories operate within the structure of central or national veterinary laboratories.

The activities described above are representative of central or national veterinary laboratories (also referred to as institutes) in most countries. If North America and Western Europe are taken as examples, these laboratories include, among others, the National Veterinary Services Laboratories in Ames, Iowa, United States of America (USA), the Central Veterinary Laboratory in Weybridge, United Kingdom (UK) (6), the 'Centre national d'études vétérinaires et alimentaires' (CNEVA) (National Centre for Veterinary and Food Studies) in Maisons-Alfort and other cities of France; the National Veterinary Institute in Lelystad, The Netherlands; the National Veterinary Institute in Uppsala, Sweden; the National Veterinary Laboratory in Copenhagen, Denmark and the National Veterinary Institute in Pulawy, Poland, etc.

As an example, the National Veterinary Services Laboratories in Ames have the following responsibilities:
- provision of diagnostic support to eradicate or control foreign (exotic) animal diseases
- provision of diagnostic surveillance to prevent the introduction of exotic animal diseases
- provision of diagnostic support for disease eradication programmes of the United States Department of Agriculture, such as those for brucellosis or Aujeszky's disease
- performance of import/export testing
- production of diagnostic reagents for domestic and foreign shipment or for use by the laboratory
- provision of reference assistance testing to other diagnostic laboratories, both within the USA and abroad
- performance of tests for other Federal agencies, such as the Food Safety and Inspection Service
- provision of diagnostic testing for veterinarians in private practices
- research to develop or adapt new diagnostic techniques
- provision of training

(J.E. Pearson, personal communication).

The Centers for Veterinary Biologics of the USA test master seeds and cells for purity and safety and new batches of vaccines for purity, safety, potency and efficacy. These Centers also perform tests in relation to reports of problems with a vaccine, test licensed vaccines for purity and potency, develop reagents to evaluate vaccines and develop new techniques to evaluate vaccines (J.E. Pearson, personal communication).

The role, importance and responsibility of Group 1 laboratories, and particularly of the central or national veterinary laboratories, in the protection of animal health is increasing on account of the dynamic development of animal production which has taken place over the last few decades in many countries and the formation of large production and breeding farms. This increased importance is also critically connected with the development of the national and international movement of animals and animal products. The prevention, control and eradication of infectious animal diseases would be impossible without the participation of these laboratories in activities of the national Veterinary Services.

Objectives of veterinary research laboratories

The achievements of central or national veterinary laboratories and other laboratories in Groups 1 and 2 would be considerably reduced, and practical applications would be of a lower standard, without the results of the veterinary research laboratories (Group 3). In other words, the role and importance of veterinary research laboratories in animal health protection, especially in the diagnosis, prevention and control of infectious animal diseases and the prevention of zoonoses, should be given appropriate recognition.

Moreover, the results of research performed in these laboratories make a significant contribution to knowledge in the fields of biology and comparative medicine, as illustrated by some examples in Western Europe and Asia.

The Institute for Animal Health in the UK belongs to the group of veterinary research laboratories which focus on basic research (2). This Institute has laboratories in Compton, Pirbright and Edinburgh and is administered from Compton. The mission of the Institute is to understand the process of infectious diseases and, using that knowledge, to develop methods for disease control, thereby enhancing industrial competitiveness and the quality of life. The Institute fulfills this mission in the following ways:
- by conducting fundamental and strategic research on the pathogenesis of diseases, thereby uniquely addressing a vital area of the life sciences
- by advancing knowledge of existing and new diseases, including those exotic infections that could spread to the UK
- by developing disease control measures to increase the efficiency of agriculture, thereby enhancing the competitiveness of products from the UK whilst simultaneously protecting and improving the environment, maintaining the integrity of the food chain and furthering the welfare of farm animals

- by contributing to the improvement of the quality and safety of food, with particular reference to those infections which may be transmitted from animals to man.

Further examples of veterinary research laboratories with activities of basic studies in the field of veterinary medicine are the Moredun Research Institute in Edinburgh, UK (3) and the National Institute of Animal Health in Japan. The role and importance of these institutes are directly linked to integrated molecular, cellular and animal studies on the aetiology, epidemiology, pathogenesis, immunobiology and control of those animal diseases which undermine biological efficiency, impair welfare or threaten public health. The Moredun Research Institute aims to achieve the following:

- improvements in animal health through research of scientific distinction and veterinary relevance, with emphasis on endemic and emerging diseases of sheep and other ruminants important for Scotland and other highland areas of Great Britain

- provision of the resources and environment in which innovative basic and strategic research can flourish and encourage international collaboration

- promotion of dynamic multidisciplinary studies of selected animal pathogens, the diseases which they cause and the response of the infected host

- contribution of new knowledge to biological science, comparative medicine, environmental protection and public health

- achievement of early uptake of research output through active technology transfer.

The Federal Institute of Viral Diseases of Animals in Tübingen, Germany, which has branches in Wusterhausen and in Riems (now the headquarters of the Institute) belongs to a group of scientific and research institutes which perform exclusively or mainly basic research (1). The Institute concentrates in particular on those viral diseases of animals which occur in farm animals and cause significant economic losses. Emerging diseases receive priority. New methods are also developed for virus identification using molecular biology and biotechnology.

At the 'Institut national de la recherche agronomique' (INRA) (National Institute of Agricultural Research) in France, the Department of Animal Pathology performs mainly basic studies, the results of which are used in application, initiating progress in the activity of specialists working in the CNEVA, regional diagnostic laboratories and factories producing biopreparations. In the field of infectious diseases of animals, the following areas of research at INRA deserve mention:

- the biology of bacteria, viruses and prions and mechanisms of pathogenicity

- the response of animals to pathogens, including immunology, immunopathology and genetic resistance.

These activities are organised into eight research programmes, of which the following deal with infectious diseases: emerging diseases; mechanisms of pathogenicity, immunity, immunisation and vaccines; genetics of disease resistance and gene transfer.

Conclusions

Veterinary laboratories which co-operate directly with the national Veterinary Services (Groups 1 and 2) assist in the diagnosis, prevention, control and eradication of infectious diseases by providing laboratory investigations in which laboratory methods are applied or by producing vaccines and diagnostic kits. Research workers at those veterinary laboratories improve applied laboratory techniques. In other words, the aim of this research activity is to adapt original research achievements for practical purposes. The activities of veterinary research (Group 3) laboratories, which are engaged in the elucidation of previously unexplained phenomena and which perform basic studies, aim to obtain new results which will form the basis for progress and modernisation of research activities and services of veterinary laboratories in Groups 1 and 2. The veterinary research laboratories also make a decisive contribution to science by new and very significant discoveries for the development of biology and comparative medicine.
Le rôle et l'importance des laboratoires vétérinaires pour la prévention et le contrôle des maladies animales infectieuses

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Résumé
Les laboratoires vétérinaires spécialisés dans les maladies infectieuses se répartissent en trois groupes selon les missions qui leur sont confiées. Le premier groupe comprend les laboratoires vétérinaires centraux ou nationaux, les laboratoires de référence nationaux ou internationaux, les laboratoires de haute sécurité et les laboratoires vétérinaires de diagnostic relevant du département, de la région ou de l'État. Le rôle majeur de ces laboratoires est d'aider les Services vétérinaires nationaux à diagnostiquer les maladies animales infectieuses. Le second groupe rassemble les laboratoires qui produisent des trousses de diagnostic ou des vaccins vétérinaires. Le troisième est composé de laboratoires de recherche vétérinaire, dont l'activité est, en général, concentrée sur la recherche fondamentale et qui ne contribuent pas directement au diagnostic et à la prévention des maladies animales infectieuses. L'auteur décrit les objectifs de chacun de ces trois groupes de laboratoires.

Mots-clés

Función e importancia de los laboratorios veterinarios en la prevención y el control de enfermedades animales infecciosas

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Resumen
En función de la responsabilidad que tengan asignada, los laboratorios veterinarios que trabajan en el campo de las enfermedades infecciosas se inscriben en tres grupos distintos. En el primero figuran los laboratorios veterinarios centrales o nacionales, los laboratorios de referencia nacionales o internacionales, los laboratorios de alta seguridad y los laboratorios veterinarios de diagnóstico de ámbito comarcal, regional o estatal. El principal cometido de esos establecimientos es el de prestar apoyo a los respectivos Servicios Veterinarios nacionales a la hora de diagnosticar enfermedades animales. En el segundo grupo se encuentran los laboratorios que fabrican kits de diagnóstico veterinario y los que elaboran vacunas veterinarias. El tercer grupo está formado por los laboratorios de investigación veterinaria, que por lo general se centran en la investigación fundamental y no participan directamente en el diagnóstico y control de enfermedades animales infecciosas. El autor describe los objetivos de cada uno de esos tres grupos de laboratorios.

Palabras clave
References


