

## An integrated approach to infectious diseases in the UK

The regular emergence and re-emergence of infectious diseases presents a significant challenge to both human and animal health. The term 'one medicine' describes the interplay between human and veterinary medicine using a common pool of knowledge between the two sectors and exploiting the opportunities offered by animal disease science to provide insights into human medicine (Kahn *et al* 2005, Zinsstag *et al* 2005). Whilst microbiologists have always concentrated on the type of pathogen rather than the host, this is not the case within Government agencies.

An integrated approach requires collaborative efforts between human and veterinary medicine – in funding agencies and Government departments as well as by researchers. This document highlights potential benefits and challenges associated with a more integrated approach to infectious disease research within the UK. The document was put together by a range of experts in human and veterinary disease from academia and industry. It has been approved on behalf of the Royal Society's Council by Professor Jean Thomas DBE FRS, Biological Secretary and Vice-President of the Royal Society.

### Summary of key points

- A more integrated approach to infectious diseases would lead to overall improvements in public health and decrease response times to major outbreaks.
- There is a need for adequate support for research into all diseases that pose a serious threat, not simply those of high political exposure.
- A national policy for infectious disease of both humans and animals is needed. An independent, interdepartmental Advisory Committee on Infectious and Zoonotic Diseases should be created to inform this policy.
- Research funding should be directed at longer term requirements in addition to immediate and ongoing research needs.
- Due to the high cost of epidemics there is a strong economic argument for protecting the future of the UK's precautionary research base through increased investment in infectious disease research.
- The redevelopment of the Institute for Animal Health (IAH) facility at Pirbright should be a priority.
- A National Institute for Infectious Diseases (NIID) should be created to bring together human and animal research.
- Effective organisational structures are required to avoid the fragmentation of research support and policy that currently results from the different funding mechanisms for animal (eg through Defra and BBSRC) and human (eg through DH and MRC) health research.
- Training and skills gaps, for example in vector biology and entomology, need to be addressed.
- There should be better integration of the teaching of medical and veterinary students.

### **The need for a more integrated approach**

The need for greater adoption of the one-medicine concept is becoming increasingly apparent, for several reasons:

#### *Benefits to public health*

Synergistic efforts can lead to overall improvements in public health, and to the prevention and treatment of disease affecting humans and animals, thus decreasing response times to major incidents. An example of interplay between the animal and human health sectors is demonstrated by the planned response to H5N1 influenza and a potential 'flu pandemic, in which expertise from the Veterinary Laboratories Agency, Institute for Animal Health, Health Protection Agency, National Institute for Biological Standards and Control and National Institute for Medical Research is being brought together with that from various University departments.

The need for greater synergy between human and animal health sectors and policy is also demonstrated by increasing environmental pressure for the emergence of new diseases, for instance due to climate change, particularly for zoonoses (infections transmissible between vertebrate animals and humans). Prevention and treatment of zoonotic diseases successfully requires a combination of expertise from both medical and veterinary sectors. In addition, improved integration of medical surveillance and surveillance of the wildlife trade would allow earlier detection of diseases that cross over between wildlife and humans, thus allowing more time to prepare for the consequences. However, as new technologies enable infections to be identified more rapidly, it may prove to be a more cost-effective option to wait for the infection to appear rather than to undertake surveillance of the wildlife trade. This needs to be investigated further. Adopting a more integrated approach would also facilitate greater understanding of issues around food safety and security that require both medical and veterinary expertise, since diseases can be transmitted in infected meat.

#### *Benefits to industry*

There is currently little collaboration between the human and veterinary sectors in industry, in part due to political and commercial sensitivities relating to data sharing and intellectual property issues. However, closer working between the two sectors would have a number of benefits. For example, vaccine and drug development can usually proceed much faster in the veterinary sector than in the human medicines sector. This is mainly due to a different regulatory environment, particularly in relation to early phases of development, and the ability to conduct direct challenge studies. For zoonoses therefore, veterinary studies can establish a strong proof of concept for human medicines. The benefits conferred from human and veterinary researchers working together are exemplified by the Jenner Institute (a joint venture between the Institute for Animal Health and Oxford University), which works to develop vaccines against major global diseases of both humans and livestock.

In addition, animal models of human diseases are useful for demonstrating proof of concept for new products aimed at humans. Improved integration would lead to better animal models for human infectious agents and infections, as information from the animal sector would be more readily available to researchers working on infectious diseases of humans. An example is the construction of transgenic animals with human immune response genes, for which information from both the animal and human sectors is needed.

### **Facilitating a more integrated approach**

Since the underpinning science of infectious disease is common to both the human and animal health sectors, better integration of medical and veterinary expertise would enable a number of areas to be built upon in a more integrated structure. For example, a common pool of knowledge in microbiology,

immunology, physiology, pathology and epidemiology could be assembled and greater knowledge could be built in genomics, and pathogenesis of, disease shared by animals and humans. However, a number of challenges must be overcome to achieve greater integration.

#### *Government policy*

Current organisational structures do not support the one-medicine approach. Government departments are divided according to human/animal (DH/Defra) diseases which makes a joined-up agenda difficult. It is currently unclear which Government department has overall responsibility for infectious diseases of both humans and animals at a policy level. A clear national policy is essential to achieve greater integration.

Concern has been expressed in the veterinary sector that the status and influence of veterinarians has declined. Greater integration will require leadership from researchers and the veterinary profession. There are further concerns that the processes involved in formulating and implementing national animal disease control policies are not optimal and it is essential that national policy on infectious diseases is informed by independent scientific advice, for example, through creation of an independent, interdepartmental Advisory Committee on Infectious and Zoonotic Diseases.

#### *Better co-ordination of research support*

A holistic approach to infectious disease research is required, for example, to take into account epidemiology influenced by climate change and the protection of commodity animals and food supply as well as human health.

However, infectious disease research is fragmented, with research into human infectious disease supported by the Medical Research Council (MRC) and the Department of Health (DH), whilst research into animal infectious disease is supported by the Biotechnology and Biological Sciences Research Council (BBSRC) and the Department for Environment Food and Rural Affairs (Defra). There is also further allocation of research funding responsibility according to whether a disease is exotic or endemic to the UK. This has a negative impact on both UK and developing country researchers funded by UK bodies.

Fragmentation is also observed in the support given for basic and applied research. Such disconnect in trans-departmental support for infectious disease research is detrimental to the application of scientific knowledge in the containment and control of outbreaks of infectious diseases; it can lead to research being carried out in silos and prevent the translation of discoveries in fundamental research into new treatments.

The UK should continue to play a role in the international co-ordination of infectious disease research. Some infectious diseases such as bovine spongiform encephalopathy (BSE) and foot and mouth disease (FMD) have been particularly catastrophic for Britain and a national capacity to respond to disease threats is critical. Epidemics can cost billions and so there is an economic argument for the UK to protect the future of its precautionary research base rather than relying on research from overseas. There is also significant skills strength in the UK in both academic centres and research institutes, reflected by the recognition of several centres as world reference laboratories. It is important for the UK to continue to use this capacity to further the global knowledge base.

#### *Balance of financial support*

With specific reference to animal diseases, there are imbalances in the type of support given to research by Defra and BBSRC. Previously, Defra has supported research into animal diseases whilst BBSRC has supported longer-term research into human and animal diseases. However, over many years the relative proportion of funding has changed and BBSRC is now the largest funder of animal disease research. BBSRC funds basic research and therefore this shift has resulted in a reduction of focus on the more applied aspects of infectious diseases.

It is also important to note that both human and animal disease research are unusually long term. However, funding cycles are typically short term, and therefore it will be increasingly difficult to give adequate attention to long term needs. To be effective, funding must be available to cover both immediate and ongoing research needs such as in diagnosis and surveillance of diseases, and science with long-term goals such as identification of protective antigens and an understanding of the immune response to infection for vaccine development.

#### *Research Infrastructure*

There are immediate challenges associated with the existing facilities and skills base infrastructure for animal health research, which is weakening. For instance, immediate investment in the Institute for Animal Health (IAH) facility at Pirbright is essential. Losing this infrastructure could seriously hamper our ability to deal with future infectious disease outbreaks and in carrying out the research to formulate new policies to control emerging infections. The House of Commons Innovation, Universities, Science and Skills Committee report on *Biosecurity in UK research laboratories* found this to be of considerable national importance.

In addition, animal disease research requires specialised experimental animal containment facilities. Because of the physical resource requirements, and for better integration of the science, work on contagious pathogens should largely be consolidated on a single site. This may not be compatible with human disease research which often needs to be in close proximity to clinical departments. Therefore other mechanisms may be required to bring together animal and human disease research interests, for example the creation of a National Institute of Infectious Diseases (NIID). This is supported by the recommendations of the 2008 Anderson report on lessons learnt from the 2007 foot and mouth disease outbreak (Anderson 2008). Such an institute would focus on basic and applied research in animal and zoonotic diseases, with the capacity to respond to national emergencies through surveillance, control and eradication. Whilst one node of this centre could be based at Pirbright, it would require support by a number of other physical centres (including HPA Porton Down, Veterinary Schools and Universities). A single organisational structure would be required to avoid the fragmentation of research support and policy that currently results from the different support mechanisms for animal (eg through Defra and BBSRC) and human (eg through DH and MRC) health research.

#### *Training and skills*

The UK is well placed to benefit from greater integration as it has considerable expertise in human and veterinary infectious diseases, mathematical modelling and systems biology. However, if it is to do this effectively there are training and skills gaps that will need to be addressed. For example, the perceived decline in UK research strength in vector biology and entomology, which underpins a significant amount of epidemiological research, must be reversed in light of a changing environment and the consequent threats from an increased geographical range of important disease-carrying vectors.

Drug development and target identification, vaccine studies, large animal infection studies and microbial diagnostics are critical research areas of science that are important in combating infectious disease, therefore it is essential that the skills base in these areas is maintained.

In addition, there is scope for better integration in the teaching of medical and veterinary students. This might be addressed through the teaching of 'one-health' modules or a national summer school for veterinary, medical and science students in infectious disease. One-medicine modules already exist in the USA, where there is greater awareness in general of the one-medicine approach. This is exemplified by the American Medical Association (AMA) resolution 530 (A-07), which acknowledged the importance of greater collaboration between human and veterinary medicine covering medical education, clinical care, public health, and biomedical research.

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### **Other Royal Society work in this area**

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