Infectious diseases: research to help detect, identify and protect

The Foresight Detection and Identification of Infectious Diseases report and action plan published today (April 26) raises some key issues for the Research Councils to consider in their future strategies and policies.

The Research Councils, who invest almost £3bn a year of public funds in basic research, have a wide ranging portfolio of research that can help us to improve our detection and identification of infectious disease and further efforts to protect both humans and other animals. The examples below are some highlights of Research Council funded research in this area.

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Fighting infectious disease with high power computers

The threat of natural pandemics, such as potentially posed by avian influenza, or major animal disease outbreaks, such as the 2001 foot and mouth disease epidemic has shown the need to develop detailed models to understand how diseases spread.

Researchers at the HPA Porton Down laboratory, funded by EPSRC, are using high performance computers to study census data and produce the most accurate model yet for the potential spread of infections in the UK. The model will account for the wide range of differences in population density and movement patterns across the country.

The project, led by Dr Steve Leach, uses parallel processing to model the interaction of local populations, which then interact with travellers on longer journeys, such as commuters or tourists. The researchers face a major challenge in creating biologically realistic models and using records from flu epidemics to fine tune the simulation. Once refined, the model will be able to predict the course of future outbreaks and inform control policy.

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Understanding the 1918 influenza virus

The Spanish Flu Pandemic of 1918 is considered by many to be one of the most deadly pandemics in recent human history. Estimates suggest that 50 to 100 million may have died from the virulent H1N1 influenza virus during 1918-1919.

Understanding how the 1918 virus was transmitted from poultry to humans has been crucial in furthering our understanding of how future influenza pandemics may occur. Researchers from the MRC’s National Institute for Medical Research, using the Synchrotron Radiation Source (SRS) at CCLRC’s Daresbury Laboratory, used x-ray crystallography to study the structure of the 1918 influenza virus’s haemagglutinin – the parts of the virus that enable it to bind to the cell being infected. The characteristics of these may have contributed to the explosive nature of the outbreak – the virus spread around the world in six months, infecting a quarter of the global population in an era before widespread travel.

The SRS has also been used to uncover the structure of part of the Mouse Leukaemia Virus retrovirus. Understanding the molecular mechanisms underlying retroviruses could lead to a better knowledge of human infections such as HIV.

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Deep-sea research could help defeat MRSA

Scientists led by Professor Alan Bull at the University of Kent were using new techniques to detect microscopic organisms in the sediment beneath the deep ocean floor when they discovered new species of actinomycete bacteria – which have antibiotic properties that could be used to inhibit MRSA.

The researchers found a chemically unique antibiotic, abyssomicin C, in one actinomycete species which could be used to combat the hospital ‘super-bug’. The bacteria were discovered with support from NERC and partners in Germany. Microbiology at deep-sea depths is difficult and expensive, with significant challenges in recovering material from beneath the seafloor and bringing it up thousands of metres to the surface.

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Culture, history and infectious diseases

Today most of us are aware that bacteria, friendly and unfriendly, are lurking all around us, in the air, at our desks, and in our homes. However, in the earliest days of bacterial discovery, public understanding about what caused an epidemic was limited, and people were only just beginning to incorporate new medical knowledge into their everyday lives. With doctoral funding from the AHRC, Rosemary Wall, of Imperial College London, is exploring how this understanding developed during the late nineteenth and early twentieth centuries, when expert knowledge on these matters was in its relative infancy.

This period saw deliberate efforts to educate the public, through advertising, magazines and health manuals. Responses to epidemics changed from fatalism before bacteriology, to fear and panic, to proactive responses, and then added to this later, blame and issues of responsibility. In one example in Croydon, in 1937, local residents teamed up to find out how a typhoid epidemic came about.

AHRC will be taking the recommendations from the Foresight programme and considering the implications for its provisionally titled Religion and Society Programme. AHRC’s role as the principle public funder of arts and humanities research in the UK is well placed to help us understand why so many attempts at the prevention, detection and identification of infectious diseases fail. Developing knowledge of belief systems and culture is crucial to understanding and explaining what causes or limits to spread of infectious disease.

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Understanding the threat to UK livestock from exotic disease

As climate change encourages the spread of traditionally tropical diseases further towards temperate areas, researchers part funded by BBSRC are trying to understand the nature of the risk to UK livestock.

Bluetongue is potentially devastating animal disease that has spread from traditional tropical areas into southern Europe. Recent outbreaks have seen the virus that causes bluetongue being carried by different species of midge which are known to be prevalent in the UK. The disease is caused by a virus that can reproduce in all species of ruminant but severe form bluetongue most often affects sheep and some species of deer and can result in respiratory problems, swelling, fever and death.

Dr Simon Carpenter and Professor Philip Mellor, researchers at the BBSRC-sponsored Institute for Animal Health, are now trying to understand the distribution and prevalence of certain species of potential carrier Culicoides biting midges in order to predict the areas of the country most at threat should the virus spread to the UK.
Researchers at the Institute for Animal Health’s Pirbright Laboratory are world experts in many exotic animal diseases. Pirbright is also an international reference lab for foot and mouth disease. The laboratory is benefiting from a £121M redevelopment, funding by BBSRC, Defra and the Department of Trade and Industry.

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More effective tuberculosis treatment and vaccination

The Medical Research Committee (the forerunner to today’s Medical Research Council) was established in 1913 specifically to tackle the problem of TB and was instrumental in developing the first effective treatments. This tradition of using research to fight TB is still strong today. Research by Dr Stephen Jolles of the Royal Free Hospital identified a potentially more effective vaccination to TB than the standard BCG vaccination. TB is responsible for over two million deaths annually and BCG, the only current licensed vaccination, is not effective in the developing world. The research, conducted at the MRC’s National Institute for Medical Research, found that a high dose of intravenous immunoglobin (IVIg) has a greater effect in reducing the numbers of TB organisms than the bacille Calmette-Guerin (BCG) vaccination in a model organism.

As the result of a study carried out by Professor Andrew Nunn of the MRC Clinical Trials Unit, the WHO changed its guidelines regarding the treatment of TB in the developing world. Professor Nunn showed that a six-month combination therapy regimen involving rifampicin was more effective than the WHO-recommended eight-month combination regimen of ethambutol.

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Risking it all – how individual perception of risk can affect disease spread

With increased attention on the risk of a human pandemic, researchers are interested in how individuals perceive this threat alongside other uncertainties they face in their daily lives – such as the impact of new technologies, changing employment patterns and shifts in family life. In order to understand risk and how people deal with it in their every day lives ESRC is investing in research in this area.

One ESRC funded research network, The Social Contexts and Responses to Risk Network, brings together sociologists, psychologists, economists as well as experts on social policy and the media from 14 different universities across the country to study how people perceive and respond to risk in the course of their lives.

This research will help to inform public policy by contributing to improvements in the methods used to evaluate people’s responses of risk as well as by focussing on risk in everyday life rather than studying hypothetical contexts.

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About Research Councils UK

Research Councils UK (RCUK) is the partnership between the UK’s eight Research Councils. Through RCUK, the Research Councils work together to champion the research, training and innovation they support. The Research Councils are independent non-departmental public bodies, funded by the Science Budget through the Office of Science and Innovation.

Together the Research Councils invest around £3bn a year in research and training in universities, facilities and Research Councils Institutes.

For more information please visit: www.rcuk.ac.uk

The eight Research Councils are:

- Arts & Humanities Research Council (AHRC);
- Biotechnology & Biological Sciences Research Council (BBSRC);
- Council for the Central Laboratory of the Research Councils (CCLRC);
- Economic & Social Research Council (ESRC);
- Engineering & Physical Sciences Research Council (EPSRC);
- Medical Research Council (MRC);
- Natural Environment Research Council (NERC);
- Particle Physics & Astronomy Research Council (PPARC).