Fighting Infection

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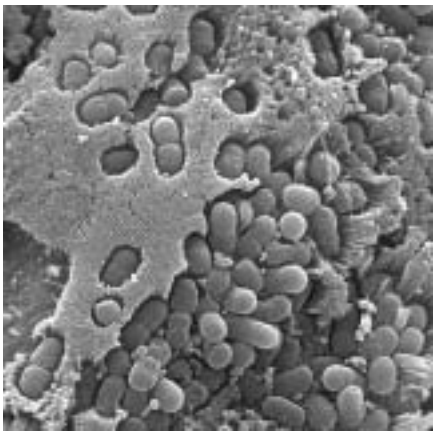
Micro-organisms – bacteria, fungi, protozoa, algae, viruses and prions – affect every aspect of our lives. The science of microbiology is important to each and every one of us. Politicians and opinion-formers are faced every day with making decisions about microbiological issues that are key to human, animal and plant health.

Since 1970 previously unknown pathogenic micro-organisms have emerged as a significant threat to human and animal health at an average rate of about one a year. SARS, BSE, vCJD, Ebola, HIV, Lyme Disease, Legionnaire's Disease, *E.coli* O157:H7 and West Nile virus have all been hitting the headlines. Many of these infectious agents have been passed to humans from animals. Now that the "golden age" of antibiotics is ending, even diseases once thought to be conquered, such as TB, are making a comeback. The scale of global travel means that infections can rapidly spread around the whole world.

Infections not only make humans ill and decimate livestock and wildlife, but they can wreak economic havoc, as demonstrated in the 2001 UK foot-and-mouth disease outbreak.

Because they are so numerous and reproduce so rapidly, micro-organisms can constantly evolve and adapt to changes in their environment. This makes it difficult for scientists to keep ahead. For example, antibiotic resistance is not a new problem. Within a very short time of the commercial development of penicillin in World War II, some bacteria were showing signs of resistance to the drug.

The fight against microbes combines the incessant struggle to gain an upper hand over known pathogens and the never-ending vigilance required to overcome anticipated and unexpected outbreaks of new or evolved species.



Cultured human small intestinal mucosa infected with enteropathogenic* E. coli *(Credit: Stuart Knutton, University of Birmingham).

MRSA

MRSA is a prime example of a continuing struggle against microbes. MRSA are *Staphylococcus aureus* bacteria that have evolved resistance to the methicillin class of antibiotics. These bacteria live harmlessly in the noses of many people, but in the very old and young and in patients that are already unwell they can cause disease. Infections caused by MRSA are treated with the last remaining reliable antibiotic class, vancomycin. This drug is expensive, has side-effects and has to be administered in hospital. Even with treatment, 25% of patients with MRSA bacteraemia will die. This equates to approximately 5,000 people each year in the UK.

The UK has one of the highest rates of MRSA infection in Europe. About 40% of *Staphylococcus aureus* infections in UK hospitals are due to these strains. So how do we fight it? MRSA is already established in our hospitals. It is found on equipment, beds, floors, furnishings, sinks, etc, and simple cleaning is often not enough to get rid of it. MRSA is also found in the noses and on the hands of patients, visitors and healthcare workers. In the UK, we do not routinely screen all patients and staff for carriage of MRSA.

There are no simple solutions to stopping the spread of *Staphylococcus aureus* or MRSA. Reductions in infection rates can be achieved through greater awareness, more hand-washing resources, screening and infection control, and isolation of patients and staff carrying the bacteria. The recent introduction of MRSA bacteraemia reporting is starting to have an effect.

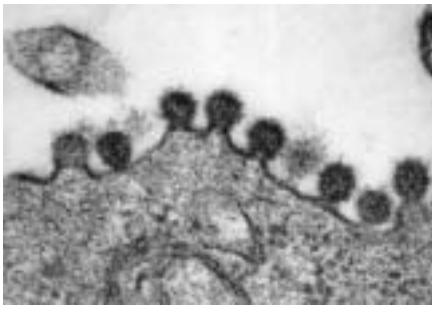
But these measures alone will not eradicate MRSA. Since 2002, three cases of fully vancomycin resistant *Staphylococcus aureus* (VRSA) have been reported in the USA. It would be irresponsible not to expect cases in the UK and we must prevent VRSA from getting established in our hospitals. VRSA may be untreatable and no one will want to go to hospital if they have a chance of catching this potentially fatal infection.

Many large pharmaceutical companies have closed their research programmes for developing new antibiotics. Lack of potential profits and tough regulations mean that companies will not invest time and money in this. A small number of companies are developing vaccines, but none so far have been found to be effective against MRSA. With no new drugs or vaccines available, ring-fenced funding for research is essential.

MRSA experts believe that we cannot control infection without greater understanding and more tools. UK Government investment is needed to develop new rapid diagnostic tests, better treatment for patients, improved surveillance and above all fundamental research into all aspects of this terrible infection and how it spreads.

Avian 'flu

Avian influenza, a virus infection commonly called bird 'flu, is an illustration of a microbiological problem requiring international



Transmission electron micrograph of budding influenza virus (x 200,000 magnification).

contingency planning. This economically important disease for poultry farmers is mainly found in the Far East. It can spread to humans who come into contact with infected birds. Luckily this is rare and involves only some strains of the virus, but cases over the past nine years have raised concern that the world may be on the brink of an influenza pandemic. H5N1, the causative strain, is primarily found in poultry and although the number of people infected is relatively few, in them it causes severe disease and the death rate is above 70%. Unfortunately, because the virus is very similar to human influenza virus there is a risk of the two types combining into a form that both causes severe disease in humans and spreads as easily from person to person as human 'flu. The effects of this could be devastating.

In the face of this danger, governments are stockpiling antiviral drugs and work is under way to develop a suitable strain of H5N1 that could be used to make new vaccines. The National Institute for Biological Standards and Control has already solved the first significant problem to emerge. H5N1 is too dangerous to use for vaccine development and so scientists at NIBSC have manipulated the virus and removed the features responsible for causing disease. This strain is now being used by vaccine manufacturers in their research.

The second problem is how to stimulate proper protection in people. Information so far suggests that for any potential pandemic, vaccination tactics will need to be different from those in current use. Further research is urgently needed to design immunisation strategies for the new vaccines.

Only microbiologists can make a difference

Without the unceasing work of microbiologists in hospitals, health protection laboratories, industry, universities and research institutes into the causes, diagnosis, prevention and treatment of infectious diseases, millions of people and animals would die each year. In the face of so many new challenges from microbes, the expertise of microbiologists has never been more needed.

The development of improved services to control and prevent infection was flagged as a priority for the Government in the House of Lords Science & Technology Committee 2003 report Fighting Infection. Recommendations include the facilitation of greater collaboration between experts and the recruitment of more specialists. Reports into animal health which resulted from the 2001 foot-and-mouth outbreak made similar proposals. Yet despite these recommendations, there is a shortage of clinical microbiologists in our hospitals and many research institutes working on animal and human infectious diseases are facing cuts in funding and thus in staff.

Microbiologist at work.

Microbes will inhabit Earth long after the human race is extinct. The need for skilled microbiologists and funding for microbiology will exist as long as human life itself. Governments around the world cannot ignore the fact that the fight against infection will never end, but that if they invest in microbiologists some of the battles can be won.

Further reading:
Enright, M. (2005). *Microbiology Today* 32, 48.
Health Protection Agency *Staphylococcus aureus* website (http://www.hpa.org.uk/infections/topics_az/staphylo/menu.htm).
Health Protection Agency avian influenza website (http://www.hpa.org.uk/infections/topics_az/avianinfluenza/menu.htm).

society for general Microbiology

The Society for General Microbiology (SGM) Microbiology Awareness Campaign aims to alert parliamentarians and government departments to the important issues relating to infectious disease and the need for adequate funding of surveillance and research. It has recently been acknowledged as a source of advice on exotic infectious diseases imported into the UK within the contingency plans of the Department for Environment, Food and Rural Affairs (DEFRA).

The SGM was founded in 1945 to bring together scientists involved in all areas of microbiology and, with a current membership of over 5,500, can offer impartial and expert information to politicians and civil servants on all microbiological topics. The Society responds to relevant government consultation documents, produces occasional briefing papers on microbiological themes and offers a free subscription to its magazine *Microbiology Today* to all Parliamentarians.

As well as promoting microbiology through its grants, prize lectures, education and public understanding of science activities and its high profile role in UK and international biological organizations, the SGM holds international scientific meetings and publishes cutting edge research findings in its four prestigious journals.

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