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WHO Publications
New Director-General takes over at WHO

For the first time, WHO is headed by a woman. Aged 59, married, a mother of four and grandmother of seven, Dr Gro Harlem Brundtland took office as Director-General of the Organization on 21 July 1998.

I refer to tobacco. I am a doctor. I believe in science and evidence. Let me state here today: tobacco is a killer.”

The new Director-General plans to increase the number of women employed by WHO. Among her other declared intentions for WHO are: to help to monitor, roll back and where possible eradicate communicable diseases; to fight to reduce the burden of noncommunicable diseases; to help countries to build sustainable health systems; and to speak out for health and back the case for health actions with solid evidence.

Dr Gro Harlem Brundtland’s nomination to the post of Director-General of the World Health Organization (WHO) was confirmed by the Member States during the 51st World Health Assembly which met in Geneva in May, and she began her five-year term of office on 21 July.

In her speech of acceptance after taking the oath of office at the World Health Assembly on 13 May 1998, Dr Brundtland referred to the complex processes of transition with which WHO must cope, and commented: “The transition from one century to another sees changes which will be faster and more dramatic from an economic, social and health perspective.” She warned the delegates: “WHO can and must change. It must become more effective, more accountable, more transparent and more receptive to a changing world.”

The burden of disease is the burden of unfulfilled human development, she went on, and announced among the first projects to be tackled by WHO a drive to “Roll Back Malaria” by developing a new health-sector-wide approach to combat the disease at global, regional and country levels. Her second emphasis will be “to address a major cause of premature death which is dramatically increasing, killing four million people this year and – if we let it go on without action – ten million people in the year 2030....

Dr Gro Harlem Brundtland, the newly elected fifth Director-General of WHO. Photo WHO/H. Anrenden
Zoonoses – diseases passed from animals to humans

David L. Heymann

Many of the human diseases that are emerging and re-emerging at the close of the 20th century are caused by pathogens originating from an animal or from products of animal origin. A wide variety of animal species, both domesticated and wild, act as reservoirs for these pathogens, which may be viruses, bacteria or parasites. Quite apart from their direct impact on human health through the sickness and death that they cause, these zoonoses can have dramatic economic consequences, especially for people who depend on livestock for survival.

Zoonotic diseases can rapidly cause extensive human suffering and death. For example, a recent outbreak of Rift Valley fever in Kenya caused tens of thousands of human cases and hundreds of deaths; this virus is transmitted to humans through mosquito bites and direct contact with infected animals, mainly cattle and sheep (see p.7). Other zoonotic diseases can spread invisibly, at least at the outset. New variant Creutzfeldt-Jakob disease (nvCJD), for instance, almost certainly caused by the bovine spongiform encephalopathy (BSE) agent, has an unknown average incubation period; estimates vary from 10 to over 20 years. nvCJD causes rapid and fatal brain degeneration when it appears, but it is not yet known how many human beings were infected before appropriate control measures were taken. It could be very few, but it could be thousands, or more (see p.8).

Considering the wide span of animal species involved and the usually complex natural history of the pathogens concerned, the effective surveillance, prevention and control of zoonotic diseases pose a real challenge to public health. The alteration of our environment and the establishment of human settlements in formerly uninhabited areas, particularly in the tropics, are two further factors that favour the emergence of diseases whose agents may have remained for centuries in nature. To these are added the ever-greater demand for animal protein foods, the acceleration of international trade, and the increasing number of people who are potentially more susceptible to opportunistic infection by agents of animal origin. Further problems stem from the use of antimicrobial substances in food animals, including their use as growth-promoters. Therapeutic use of antibiotics in animals, as in humans, is necessary, but some major animal pathogens responsible for outbreaks of foodborne diseases in humans are now proving resistant to the antibiotics used in human medicine. This has to be taken into account in the overall strategy to control antimicrobial resistance.

WHO's task in this increasingly important area of public health is to strengthen the capacity of countries and the international community to prevent such dangers from developing, and to minimize their impact on public health. To do this, the Organization works with its partners within a global framework to reshape and strengthen the network for communicable disease surveillance and control. The aim is to detect and contain the spread of viral, bacterial and zoonotic diseases where and when they occur.

This issue of World Health looks more closely at some of the problems involved and the ways in which they can be solved.
Animals that infect humans

François-Xavier Meslin & Klaus Stöhr

Equine encephalitis

An epidemic outbreak of Venezuelan equine encephalitis (VEE) was reported in the border area between Colombia and Venezuela, starting in early September 1995. By the end of that month, 8825 human cases of VEE had been reported, and four deaths had occurred in Venezuela. In Colombia, more than 450 cases were reported. This is the most severe of several viral diseases in horses, and the virus can be transmitted to humans by mosquito bites. Most infections are relatively mild, but symptoms include severe headache, chills, fever, muscular pain, nausea and vomiting; fewer than 1% of cases are fatal. Outbreaks can be prevented by the regular immunization of horses carried out within the framework of public health programmes.

Monkeypox

Monkeypox is a viral disease occurring in monkeys and squirrels in the rain forests of central and western Africa. It is transmissible to humans and causes a syndrome similar to smallpox. In 1996 and 1997, more than 500 suspect cases of human monkeypox were reported in the Kasai Oriental province of the Democratic Republic of the Congo. Many of the cases were in children under 16 years old. No deaths were reported, and by the end of 1997 transmission appeared to have ceased at the site of the outbreak and in the surrounding villages. The two investigations conducted on site by WHO indicated that person-to-person transmission accounted for most of the cases that occurred at that time, in contrast to sporadic earlier cases, which had been caused by animal-to-human transmission. Further analysis will help to elucidate the risk factors for transmission.

Ebola and Ebola-related viruses

In 1976, the Ebola virus attracted worldwide attention with the outbreaks in Zaire (318 cases) and Sudan (284 cases), both showing very high case mortality rates (53% in Sudan and 88% in Zaire). The first patients may have been in contact with infected animals or their products (bats or rodents in Sudan, meat from monkeys or wild antelopes in Zaire), but investigations into the possible animal reservoir remained inconclusive. Further sporadic cases were reported in the following years, and in January 1995 a new Ebola epidemic was reported in Kikwit, Zaire, with a total of 315 cases and 244 deaths. The following year two outbreaks occurred in Gabon, causing about 40 deaths; most of the patients there had been in contact with a dead chimpanzee which had been butchered for food. However, nothing definite is known about the reservoir of Ebola virus, although certain species of monkey and apes seem to be the only animal victims of the disease in the wild. Consequently, WHO has initiated a multidisciplinary study in the Tai forest in Côte d'Ivoire to track down the natural reservoir of the virus; this is essential to understand the mechanisms of its transmission in nature and help to prevent future outbreaks. Many hundreds of specimens have been collected, ranging from insects to shrews, bats and apes. The results of the study are expected to be published shortly.

Bovine spongiform encephalopathy (BSE)

BSE is a fatal neurological disease of cattle which first came to the attention of the scientific community in November 1986 with its appearance in cattle in the United Kingdom.
belong to the group of transmissible spongiform encephalopathy. At present the number of people affected with nvCJD stands at 27 in the UK and one in France.

Recent evidence from various studies further supports the hypothesis of a link between nvCJD and BSE made in March 96 on circumstantial evidence. Because of its long incubation period, the possibility of a significant epidemic of nvCJD occurring within the next 10 to 15 years cannot yet be dismissed. As exposure to the BSE agent may extend to populations outside the UK and Western Europe, WHO is strengthening global surveillance of CJD and its variants to ascertain the number and distribution of any future cases.

Outlook for the future

The rising incidence of zoonotic diseases is likely to continue in view of foreseeable global changes over the next few decades such as population growth, urbanization and climate change.

Although the prevalence of brucellosis, tuberculosis, canine rabies and other major zoonoses has been greatly reduced in industrialized countries, zoonoses prevention and control will remain an area of major concern in most developing ones. Recent observations suggest that expenses related to the prevention of zoonotic diseases in people are likely to increase dramatically in these countries in the near future if no programmes for their control in animal reservoirs are implemented. Diseases such as brucellosis, rabies and bovine tuberculosis can certainly be brought under control in most parts of the world during the first decade of the third millennium but this will require constant efforts for the next 20 to 30 years.

As zoonoses and animal diseases with potential implications for human health will continue to emerge and re-emerge, surveillance of these diseases will need to be reinforced and maintained at country level and internationally. In view of unplanned urbanization and the associated shortage of basic facilities, large cities everywhere will need a strategy for responding to human and animal health problems. At the same time, comprehensive plans will be needed to reduce rural-urban migration. These plans should include the improvement of rural employment and food availability by the promotion of animal production projects, and the improvement of health through zoonoses control and reduction of environmental pollution related to animal rearing.

In view of the usually complex transmission cycles of these diseases, further collaboration is essential between all the professions and institutions involved. This is particularly true in the field of foodborne disease prevention and control, where all professional groups involved in the food chain, from the farms where the animals are raised for food to the consumer's plate, should collaborate closely in meeting the world's need for wholesome and safe animal food products.
Rift Valley fever

Ray Arthur & Mike Ryan

A disease which attacked both humans and animals late last year in parts of Kenya and Somalia triggered a major international investigation and proved to be the viral disease known as Rift Valley fever.

In December 1997, the Kenyan Ministry of Health and WHO in Nairobi received reports of scores of unexplained deaths in the North-Eastern province of Kenya and in southern Somalia. The symptoms of those affected included an acute fever and headache followed by haemorrhaging, with bloody stools, vomiting of blood and bleeding from other mucosal sites. At the same time local health officials reported high rates of spontaneous abortion and deaths from haemorrhage among domestic animals.

Diagnostic testing of 36 human blood samples at the National Institute of Virology in South Africa and at the Centers for Disease Control and Prevention (CDC) in Atlanta, USA, confirmed acute infection with Rift Valley fever (RVF) virus in 42% of the cases. The outbreak followed torrential rains which began in late October 1997 and continued into January, causing the worst flooding in the region since 1961. Although the floods complicated efforts to track down cases, active surveillance in Kenya’s North-Eastern province, conducted by WHO, the Kenyan Ministry of Health and international relief organizations, had by the year-end identified 170 deaths from a “bleeding disease”. The killer disease waned in early February 1998, but not before it had claimed some 250 lives.

Over 3000 mosquitoes were collected in the affected zone and were found to belong to nine different species, three of which had been previously implicated in the transmission of RVF. Analysis of blood samples from humans and livestock in the North-Eastern Province of Kenya led to the conclusion that contact with livestock, including herding, milking, slaughtering and sheltering animals in the home, was associated with acute RVF infection. Livestock owners reported losses of about 70% of their animals. Other infections contributing to the high mortality in animals ranged from pneumonia to skin diseases. The scale of the outbreak and the economic losses it caused have yet to be fully assessed.

The Rift Valley fever virus was first isolated in Kenya in 1931, when it was recognized as causing high death and abortion rates in ewes and newborn lambs. The most severe epidemic was in Egypt where the virus was recognized for the first time during 1977-1978 and was associated with at least 18,000 human infections and 598 deaths, accompanied by almost universal abortion in pregnant ewes and deaths among lambs. Outbreaks in Kenya occur periodically following heavy rains which flood natural depressions and encourage the hatching of virus-infected Aedes mosquito eggs, the reservoir of the virus. Domestic animals are the amplifying hosts which infect the other mosquito species that spread the virus among the animals and to humans. Transmission to humans can also occur by contact with blood or body fluids from infected animals.

Efforts are now under way to test the feasibility of using remote-sensing satellite data to give advance warning of climatic conditions that favour the emergence of RVF and thereby help target areas for animal vaccination. These and other animal and human surveillance activities will make earlier identification of the disease possible and help the health authorities to take preventive action.

Dr Ray Arthur and Dr Mike Ryan are with the Division of Emerging and Other Communicable Diseases Surveillance and Control, World Health Organization, 1211 Geneva 27, Switzerland.
New-variant Creutzfeldt-Jakob disease

Martin Zeidler & Daniel Hahn

A group of diseases affecting the central nervous system occur in several animal species, including humans. These conditions are called transmissible spongiform encephalopathies (TSE). They can be passed from animal to animal in the laboratory and are characterized by spongy degeneration of the brain. The one that occurs most commonly in humans is called Creutzfeldt-Jakob disease (CJD). Until recently, TSEs in humans were thought to exist independently of those in other animals, but now the agent which causes them appears to have crossed the species barrier. At present there is no reliable pre-symptomatic test for TSE and no effective treatment has yet been found that can stop the underlying disease process.

A TSE affecting cattle – bovine spongiform encephalopathy (BSE) – was first reported in the United Kingdom in 1986, and since then about 170,000 cases have occurred in that country alone. Small numbers of BSE cases have also been reported in native cattle in Belgium, France, Ireland, Luxembourg, the Netherlands, Portugal and Switzerland. Cases have also been found in Canada, Denmark, the Falkland Islands (Malvinas), Germany, Italy, and Oman in animals imported from the United Kingdom.

Food ban

It is thought that BSE was caused by animals being given feed supplements made from the remains of sheep contaminated with scrapie – a TSE that affects sheep. A reduction in the use of solvents and heat in the manufacturing process in the United Kingdom around 1980, combined with other factors, may have been the cause of the transmissible agent remaining active. In 1989 brain, spinal cord and certain other organs from cattle – the specified bovine offals (SBO) considered to pose a potential risk to humans – were banned from foodstuffs in the United Kingdom. Other European Union countries that had identified cases of BSE later established their own SBO list also banned their use in food.

Opinions differ as to the nature of the TSE agent. According to one theory (the prion theory) it is composed largely, if not entirely, of a self-replicating protein. A second theory is that the agent is similar to a virus and possesses nucleic acids which carry genetic information. Evidence gathered over the past 10 years supports the prion theory, but the TSE agent is able to form multiple strains, and this is more like the behaviour of a virus.

Four different forms of CJD have been identified: sporadic, familial, iatrogenic, and new variant.

Sporadic CJD, which accounts for about 85% of cases, usually affects individuals between the ages of 50 and 75, and is characterized by a rapidly progressive dementia, jerking movements of the limbs, and a specific abnormal brain wave pattern. The cause of sporadic CJD remains unknown and there is no evidence of a causal link with any animal TSE.

- Familial CJD accounts for 10–15% of cases and is an inherited disease associated with a gene mutation.
- Iatrogenic CJD, accounting for less than 5% of cases, results from the accidental transmission of the causative agent from contaminated materials – such as neurosurgical instruments – during medical or surgical treatment.
- New variant CJD (nvCJD) is a new disease which was first reported in March 1996 and which is probably linked with exposure to the BSE agent. Unlike most cases of CJD this variant form has affected young people. The average age of patients with nvCJD is 27 years compared with 65 years for other
forms of CJD; and the illness generally lasts longer—14 months on average compared with 4-5 months. When viewed under a microscope, the brain of patients with the new variant demonstrates a consistent but previously uninvestigated wave pattern of sporadic CJD. Blood and spinal fluid tests are normal or generally fail to identify any cases. In conclusion, the most likely cause of nvCJD is exposure to the BSE agent, probably in food contaminated by affected cattle brain or spinal cord. We do not have sufficient information to present to make any well-founded prediction about the future number of nvCJD cases.

WHO global surveillance

Since 1991 WHO has convened seven scientific consultations on issues related to animal and human TSEs. The potential future public health implications of nvCJD were examined by a WHO consultation in May 1996 and reviewed in February 1998. As exposure to the BSE agent may extend to populations outside the United Kingdom and western Europe, strengthened global surveillance in five European countries, Australia, Canada and the United States of America, and WHO is initiating surveillance in other, mainly developing, countries. It is anticipated that these activities will provide information that is important for enhancing the protection and planning of public health worldwide.
The effects of the rabies virus have been known since Babylonian times. The ancient Romans referred to the presence of a ‘transmissible poison’ in the saliva of mad dogs. The virus is usually introduced into humans through the bites of infected animals but other means of transmission are possible. Infected licks on mucous membranes and the inhalation of infected bat secretions have resulted in deaths in humans, and cases are recorded of people being infected with rabies after receiving corneal grafts from donors in whom the disease had been undiagnosed. There is no documented case of human-to-human transmission from close personal contact. Reservoirs of rabies virus exist among dogs, cats and many wild mammals, including foxes, skunks, raccoons, jackals, wolves, and bats. In much of Asia, Africa, and South America, however, it is the dog that presents the greatest risk to humans.

After entering a mammalian body the rabies virus ‘rests’ or multiplies slowly at the inoculation site. It then invades the nearest nerve tissue and slowly, over weeks or months, ascends into the spinal cord and brain. There it multiplies, causing rapid death. The undetectable incubation period ranges from a few days to many years after primary infection. In Thailand most infected humans fall ill and die within 14 to 60 days after their exposure. Although it is generally considered an invariably fatal disease a few isolated survivors have been documented. All have suffered brain damage, however.

The World Health Organization estimates the annual number of human deaths from rabies at over 50,000, but the figure could be higher because of the many deaths that go unreported in remote parts of the world. Reported deaths from rabies outnumber those due to polio, Japanese encephalitis, meningococcal meningitis, schistosomiasis, cholera and Creutzfeldt-Jakob disease. Rabies in cattle and other domestic mammals also causes economic damage.

A dog’s saliva becomes infective up to one week prior to the dog becoming ill and it remains infective up to the time of death, which is rarely longer than 10 days after onset of symptoms. Unlike humans, some dogs may survive rabies infection.

Rabies in humans is preventable by early wound cleansing and vaccination with modern vaccines. Since it takes at least 10 days for a previously unvaccinated human to develop antibodies to rabies from vaccination, anti-rabies immunoglobulin must also be administered on the first day of treatment to bridge the ‘unprotected period’. It must be injected into the bite sites to neutralize the virus. This immunoglobulin can be made from immunized humans or horses. Post-exposure treatment with vaccine and immunoglobulin provides virtually 100% protection if administered immediately and according to WHO recommendations. The problem is, however, that rabies immunoglobulins and modern vaccines are expensive and not always readily available in all parts of the world. This is why vaccines derived from crude nerve tissue, locally produced from sheep or mouse brains, are still used in nearly 90% of treatments worldwide.

Only expert post-exposure treatment using modern cell-culture vaccine can reduce the human death toll, as has been demonstrated in Thailand. The dramatic reduction achieved there was brought about by abolishing the use of nerve-tissue-
None the less, being bitten by a possibly rabid animal results in much anxiety and suffering and represents a severe economic burden.

In Thailand, as in other parts of Asia, Africa, and South America, it is mostly stray or village dogs that carry the disease. Mass vaccination campaigns are organized annually. Most stray dogs, however, have a short life expectancy resulting in rapid population turnover. They are not easily caught and vaccinated. It is estimated that in Bangkok alone there are at least 100,000 stray dogs with an average age of one and a half years and that there is approximately one dog for every six humans.

Fifteen per cent of the dogs we examined and found rabid were under the age of three months and only 10% had been vaccinated. In spite of annual campaigns by municipal authorities, approximately 80% of stray dogs caught at random in Bangkok have never been vaccinated against rabies.

A single injection of rabies vaccine does not confer long-term immunity against infection and it is rarely possible to inoculate stray dogs more than once. One solution would be to use an oral dog vaccine like the one being used successfully for foxes in Europe. Another would be to control the stray and community dog population by sterilization and destruction, but this is difficult to do in a poor tropical country owing to logistical problems and cultural and religious constraints. A neighbouring country showed in the 1950s that vigorous dog control and mandatory vaccination can virtually eliminate canine rabies.
Use of antimicrobials in food animals

Klaus Stöhr & François-Xavier Meslin

Industrial poultry production in Europe. Antibiotics are used to promote growth in food animals. This practice may threaten the efficiency of some of the drugs used to fight infection in both animals and man. Photo WHO/K. Stöhr

The use of veterinary antimicrobial substances to keep farm animals disease-free and increase production may encourage the transmission of drug-resistant germs to humans.

Antimicrobial drugs are widely used for treating infections in both humans and animals. Unfortunately, however, their use inevitably leads to the development of germs that are resistant to those drugs. Depending on the mechanisms involved and factors such as dosage, length of treatment, and how the drugs are administered, the development of resistance will be greater for certain combinations of organisms and antimicrobials than for others. Some such drugs have been in use for more than five decades, giving antimicrobial resistance ample time to develop and become a significant problem for the treatment of certain infections.

Today it is clear that most resistance problems in humans stem from the use and misuse of antimicrobials in human medicine. They are all too often prescribed for conditions in which they are known not to be effective (for instance, viral infections). Even when they are prescribed properly, patients may not comply with instructions on how often to take them, and for how long.

In some countries, antimicrobial substances are used extensively in animal and plant agriculture. Most of them are used at very low doses in livestock for growth promotion. Several of the organisms that infect humans originate from animals and are transmitted through food, water or direct contact. Some of these organisms, including Salmonella, Campylobacter, Escherichia and Enterococcus, are increasingly showing resistance, and part of this increase has been linked to the treatment of food animals with antimicrobials. Although the public health impact of resistance due to antimicrobial use in food animals is certainly small compared with that of resistance originating in humans, the situation needs to be carefully monitored. The development of resistance to certain "last-resort" antimicrobials – those that are kept in reserve for use when other drugs have failed – could have serious consequences for both humans and animals.

Questions about the use of antimicrobials in food animals have been raised and debated ever since the 1950s, when the feeding of low levels of these drugs to promote growth in food animals began. Over the years, various scientific bodies have studied the public health impact of such use but definitive answers have not been forthcoming. Perhaps the best known study was that of the United Kingdom’s Swann Committee of 1969, which recommended that for growth promotion use should be made only of antibiotics that have “little or no application as therapeutic agents in man or animals and will not impair the efficacy of a prescribed therapeutic drug through the development of resistant strains of organisms”.

Data on the extent and trends of resistance are scarce, and those that
Resistance to antibiotics often stems from misuse in human medicine. These drugs should be limited only to complaints for which they are effective, and the prescription should be scrupulously followed. Photo WHO/PAHO/A. Waak

are available consist mostly of laboratory test results that do not always correlate with data on use of growth promoters and the treatment of animals in practice. Some regulatory actions have nevertheless been taken. For instance, following the emergence of resistant enterococci (bacteria) in animals, the European Commission decided to ban the use of avoparcin as a growth promoter in poultry.

WHO’s role

Given the prevailing uncertainty about the implications of antimicrobial resistance in animals for public health, WHO’s Division of Emerging and other Communicable Diseases Surveillance and Control (EMC) has opened the debate on these issues so as to determine what should be done at national and international level. WHO organized a meeting of experts on the medical impact of antimicrobial use in food animals in October 1997.

Priority problems were reflected in the examples the participants gave of the medical consequences of resistance of animal origin. Specific organisms identified included Salmonella, Campylobacter, Enterococcus and Escherichia coli, and the drugs concerned included fluoroquinolones and avoparcin.

Evidence was presented which suggested that the use of antimicrobials in animals encourages the emergence of antimicrobial-resistant Salmonella serotypes. Such bacteria are known to be mainly transmitted to humans in food or through direct contact with animals. A recent example is S. typhimurium DT104, which is resistant to at least five antimicrobials.

Since fluoroquinolones were introduced for treatment of disease in food-producing animals, Salmonella serotypes with reduced susceptibility to fluoroquinolones have been observed in animals and isolated from food in France, Germany, Ireland, the Netherlands, Spain, and the United Kingdom. After fluoroquinolones were used in poultry, there was a significant rise in the prevalence of fluoroquinolone-resistant Campylobacter jejuni isolated from live poultry, poultry meat and humans. Before this use in poultry, no resistant strains had been reported in humans who had not had previous exposure to quinolones. However, fluoroquinolone-resistant C. jejuni have only been associated very rarely with treatment failures in humans.

Multiresistant strains of Escherichia coli have also appeared following the use of broad-spectrum antimicrobials in both livestock and humans. The development of antimicrobial resistance in E. coli gives special cause for alarm, not least because identical resistance genes have been found in E. coli both in animals and in humans.

Need for safeguards

A WHO consultation held in October 1997 recommended that the use of any antimicrobial agent for growth promotion in animals should be terminated if the same agent is used in human therapeutics or is known to favour the development of cross-resistance to antimicrobial drugs used in human medicine. National authorities were urged to define threshold levels of resistance in bacteria and ensure that no antimicrobial is administered to a food animal unless that substance has been evaluated and authorized by national authorities. It was also recommended that countries should monitor the prevalence of resistant bacteria in food-producing animal populations and animal-based food products, and that WHO should take the lead in coordinating international efforts in monitoring resistance of bacteria isolated from food of animal origin and food animals.

WHO is now planning to set up a network of laboratories which will regularly test samples from food animals and foods of animal origin and report the results to WHO. The laboratories involved will seek to establish national networks expressly to monitor antimicrobial resistance. WHO will work with other international organizations such as the Food and Agriculture Organization of the United Nations (FAO) and the Office International des Epizooties (OIE) to assess risks of antimicrobial resistance which may arise in the context of each country’s situation and needs.

Dr Klaus Stöhr is a scientist in the Zoonotic Diseases Unit and Dr François-Xavier Meslin is chief of the unit, Division of Emerging and other Communicable Diseases Surveillance and Control, World Health Organization, 1211 Geneva 27, Switzerland.
Brucellosis: a widespread public health problem

OttoCosi & Aristarhos Seimenis

Brucellosis can be prevented in humans by limiting or, ideally, eliminating the disease in the animal population and by avoiding contact with infected animals and consumption of raw milk and milk products.

Of all the zoonoses that have both public health and economic implications, brucellosis (also known as Mediterranean fever, remittent fever, Malta fever and undulant fever) is the most widespread. The first clinical description of it dates back to 1860, and the cause of the disease was discovered in 1887, when a British army doctor, David Bruce, identified the microbe, which was named after him. Later, in 1905, infected goats and their milk were identified as a source of infection in humans.

The risk to humans

The incubation period for brucellosis is usually one to three weeks, but sometimes it may be several months. Symptoms of the illness vary from mild and self-limiting to severe, though they are seldom life-threatening. Onset can be sudden or insidious, and can be accompanied by persistent or intermittent fever. The general symptoms resemble those of many other febrile diseases, but brucellosis also affects the bones and muscles, producing generalized aches and pains, and is associated with exhaustion and depression. The duration of the disease can vary from a few weeks to several months. Laboratory tests are needed to confirm the clinical diagnosis.

Brucellosis is transmitted through contaminated untreated milk and milk products, and through direct contact with infected cattle, sheep, goats, pigs, camels, buffaloes, wild ruminants and, most recently, seals. Animal carcasses and aborted fetuses are also sources of the disease. Millions of individuals are at risk worldwide, especially in countries where infection in animals has not been brought under control, procedures for heat treatment of milk (such as pasteurization) are not routinely applied, and standards of hygiene in animal husbandry are low. In countries around the Mediterranean, efforts are being made to control the disease in animals, but brucellosis persists in sheep and goats, causing widespread infection in humans. In these countries the annual incidence of brucellosis in people varies from less than 1 to 78 cases per 100,000 population. In confined endemic areas where no animal control measures are applied more than 550 cases per 100,000 population have been reported.

Reported cases do not tell the full story, however. Although human brucellosis is a notifiable disease in many countries, the true incidence is thought to be between 10 and 25 times as high as the reported figures. Very often the disease remains unrecognized as a result of inaccurate diagnosis, and is thus reported as a different disease, or as "fever of unknown origin". A recent human survey conducted in Saudi Arabia found that almost 20% of the population had had the infection and the disease was still active in over 2% of those examined. Similar figures can be expected from most countries in...
Brucellosis and WHO

Brucellosis in humans and animals is increasing in many parts of the world, including the Mediterranean region, western Asia and parts of Africa, eastern Europe and Latin America. A number of WHO programmes are aimed at strengthening brucellosis surveillance and control activities at national, regional and global levels. In collaboration with the Food and Agriculture Organization of the United Nations and the Office international des Epizooties, WHO is promoting a regional control programme in the eastern Mediterranean area. The Mediterranean Zoonoses Control Programme of WHO is coordinating a study to evaluate new treatment regimens for human brucellosis. WHO and the United Nations Development Programme are collaborating with the Palestinian Authority in a programme for the control of human and animal brucellosis in the West Bank and Gaza Strip. WHO’s Regional Office for the Americas has launched an initiative for bovine brucellosis elimination in Latin American countries. The Organization also provides information material for travellers and consumers, covering dietary precautions and such measures as heat treatment of milk and derived products. Currently WHO is preparing guidelines for the integrated surveillance of brucellosis, and promoting research on new brucellosis vaccines for both humans and animals.

Dr Ottorino Cosivi is a Scientist with the Zoonotic Diseases Unit, Division of Emerging and other Communicable Diseases Surveillance and Control, World Health Organization, 1211 Geneva 27, Switzerland. Dr Aristotelis Seimenis is Director of the WHO Mediterranean Zoonoses Control Programme, P.O. Box 66074, Athens, GR-15510 Greece.
Brucellosis in the Americas

Primo Arámbulo

Of the various species of the brucellosis bacterium, *Brucella melitensis* is the most likely to cause serious illness in humans. Next comes *B. suis*, then *B. abortus*, then *B. canis*. The main mode of transmission of brucellosis to humans is consumption of contaminated milk and cheese. Brucellosis spreads through the population where contaminated food is sold. The different stages of the disease are difficult to diagnose, and in areas where brucellosis (particularly the bovine type) recurs regularly in animals, infection is often transmitted in asymptomatic form.

The main countries in the Americas affected by this foodborne disease are Argentina, Mexico and Peru. In 1995, a total of 2699 cases of human brucellosis were reported in Mexico. In 1996, there were 3362 cases: an increase of approximately 20%. The Mexican States most affected are Guanajuato, Coahuila, Durango and Nueva León.

In Argentina, 496 cases of human brucellosis were reported in 1995 and the number increased further in 1996, to stand at 565. The provinces most affected are those with the largest goat population: Catamarca, Mendoza, Salta and San Luis.

In Peru, brucellosis recurs regularly in the departments of Ancash, Lima, Ica and El Callao, where there are epidemic outbreaks. Vaccination of goats has brought about a considerable reduction in cases among humans, but vaccination programmes which do not reach most of the target animal population or are not carried out every year lead to new outbreaks.

In countries where the disease in animals has been brought under control, it can reappear sporadically in individuals who acquire the infection from abroad, usually by consuming illegally imported and unsafe animal products. It also occurs from time to time in occupationally exposed groups such as farmers, veterinarians and laboratory and slaughterhouse workers.

In North America, efforts to eradicate brucellosis have been successful in Canada which has been free of the disease since 1985. In the United States, 141 herds were found to be infected in 1996, of which only 45 were still under quarantine at the end of that year. The United States hopes to eradicate the disease by the end of 1998, but this might not be possible because of the difficulty of vaccinating bison, which live in the wild. Annual incidence of brucellosis in humans in the United States has been below 100 cases since 1996.
Influenza – preparing for a 21st century pandemic

WHO’s global surveillance activities first identified a human infection with the avian influenza virus A(H5N1) in Hong Kong in mid-1997 at one of the Organization’s collaborating centres. The H5N1 was not previously known to cause infection in humans. The possibility that the outbreak heralded a global influenza pandemic has not materialized, but the threat of an influenza virus more easily transmitted between humans remains.

Sooner or later such a pandemic may occur, and history shows that it must be taken with the utmost seriousness. The WHO Network for Global Influenza Surveillance, which involves 110 national influenza centres, maintains constant vigilance.

New influenza viruses to which nobody is immune may cross the barrier from animals to humans at unpredictable times. These events may result in local epidemics, but a few lead to global pandemics. Influenza was first described by Hippocrates in 412 BC and about 30 possible pandemics have been documented in the last 400 years. Three have occurred in this century – in 1918, 1957 and 1968.

The 1918 pandemic of what was known as Spanish flu was by far the most devastating, killing more than 20 million people worldwide between 1918 and 1920. The virus is believed to have originated in swine. The pandemic occurred because the new virus was easily transmitted from person to person.

Birds and poultry in particular are other sources of influenza viruses, and in Hong Kong the chickens had been infected by the H5N1 virus from an animal source or reservoir in nature that is still to be identified. Then the virus was transmitted from poultry to humans. Significant person-to-person transmission does not seem to have taken place. As a precautionary measure during the outbreak, the Hong Kong authorities destroyed poultry flocks to eliminate the risk of further animal-to-human transmission, and a team of experts organized by WHO took more than 1800 samples from birds and animals of 16 species to identify the natural reservoir of the virus and the extent of its spread in animals. The results are still pending.

WHO has for many years played a leading role as a watchdog on the look-out for a pandemic, active in global influenza surveillance and in vaccine preparation. Every February, experts review results from WHO’s influenza network and make a recommendation on the antigenic composition of the next year’s influenza vaccine, which WHO transmits to health authorities and vaccine manufacturers.

Although the date of the next influenza pandemic cannot be predicted, the strong likelihood of its arrival means that emergency response plans have to be prepared in advance. WHO has created a Task Force on Influenza whose members include the directors of four main collaborating centres in Australia, Japan, the United Kingdom and the United States, WHO staff, and representatives from three of the 110 national influenza centres which collaborate with WHO on surveillance.

The Task Force is developing a plan for the global management and control of a pandemic. The plan includes the promotion of high-growth seed virus for vaccine, the facilitation of vaccine production and international distribution, and the dissemination of information and support to national health authorities. It calls for each of these authorities to develop its own emergency response to a pandemic.

The A(H5N1) outbreak in Hong Kong was the first one in which WHO pandemic planning was used, with the step-by-step collection of information necessary to decide whether or not a new vaccine was required. The outbreak also provided the opportunity to adjust the plan in line with experience. In this way the scientific information necessary to make rational decisions on influenza control is being steadily accumulated.
Improving the health of nomadic people – the example of cystic hydatid disease

Calum N. L. Macpherson

Although a low-intensity programme continues today it is felt that further reduction of the disease is in the hands of the Turkana themselves.

Between 50 and 100 million people in the world today, chiefly in Asia and Africa, lead a nomadic life. The areas in which nomadic people live have low population density and may not have roads or telecommunications. Their migratory lifestyle means that nomads are unlikely to have access to permanent educational, medical, and veterinary services or to trained personnel, and they may not have safe and sanitary water supplies. Because of these factors, and because many nomadic people live and work close to animals, they are highly exposed to zoonoses – diseases shared by vertebrate animals and humans.

The Turkana District

The Turkana people in north-western Kenya are nomadic pastoralists who practise transhumance, moving with their herds in search of pasture throughout a vast semi-desert region known as Turkana District. Their migrations follow seasonal rainfall patterns allowing them to make use of vast tracts of seasonally productive land.

There are about 65 000 Turkana people, and they keep a range of animals including sheep, goats, cattle, dromedaries and donkeys. Dogs are kept mainly for protection and domestic help. Animals represent wealth and prestige and are used as gifts to cement friendships and marriage. Milk is the main constituent of the Turkana people’s diet, on occasion flavoured with blood, and nowadays increasingly supplemented with millet, sorghum and maize. Few animals are slaughtered for meat, and there are not many abattoirs in the region; when slaughtering does take place, it is usually done at home, and the offal, which is often infected, is fed to the dogs. The lack of veterinary facilities means that meat inspection is rarely carried out and that the dog population grows without systematic control. Most people share drinking-water supplies with their animals, which include a large number of dogs.

All these factors help the transmission of a small tapeworm called *Echinococcus granulosus*, an intestinal parasite whose adult stage develops in dogs after they eat the larval stage found in hydatid cysts which grow in the organs – particularly the liver – of cattle, sheep and goats. The dogs shed the eggs of the parasite in their faeces, which in turn infect humans and domestic animals via contaminated drink or food. The eggs contain embryos called oncospheres, which become trapped in the liver and slowly develop into hydatid cysts, whose removal requires surgery.

Turkana has a higher prevalence of cystic hydatid disease than almost anywhere else in the world. This was not realized until the 1960s because patients receiving treatment at the hospitals come from so far away. When eventually it was noticed that a high proportion of these patients

Turkana people at a water hole dug in a dry river bed in north-western Kenya. Animals may infect such sources of water and thus transmit zoonoses to man. Photo C. Macpherson ©
were from the same district, studies were made, and in the mid-1980s community-based ultrasound surveys were carried out. They showed that prevalence was 5.6%, and reached 12% in those aged 35 years or more. The data also showed that almost three times as many women had the disease as men. This was thought to be due to the closer contact women in this community have with dogs, which stay around the home during the day while the men and boys are away, and are used to lick the babies clean. Close contact with infected dogs is an important factor, since in hot climates the eggs cannot survive for very long outside a human or animal body.

A high prevalence of cystic hydatid disease has also been recorded among other nomadic people in North Africa, the Eastern Mediterranean area and China, where similar socioeconomic conditions exist. In Alaska, where nomadic Eskimos were settled, the disease was found to increase because of the accumulation of dog faeces around the towns. In cooler climates eggs may survive for months, making the chances of environmental transmission even greater than in Turkana.

Pilot control programme

In 1983 a pilot control programme was started in the Turkana District which has decreased the incidence of the disease in the control area. The main strategy was to reduce infection in dogs. To do this, educational information was communicated, by means of songs, poems and discussions, about how the disease was transmitted. It focused in particular on discouraging the customary practice of cutting the hydatid cysts out of the liver and lungs of slaughtered animals and feeding them to the dogs. Stopping this practice alone, thereby breaking the life cycle of the parasite, can drastically reduce the prevalence of the disease.

Other control measures used in Turkana included reducing the stray dog population and changing the way owned dogs were treated. Praziquantel, administered in a single dose, completely frees a dog from infection, but the drug is very quickly metabolized, so reinfection can occur as early as the following day. Thus regular deworming treatments are necessary if the dogs are to be kept worm-free by this means. The timing of such events took advantage of seasonal migrations and cultural events. Weddings are held mostly in the wet season, so drugs could be administered to the dogs during this period when more animals are slaughtered for food. In the dry season, when fewer animals are slaughtered, the interval between drug administration could be increased.

During the dry season people and animals concentrate around the few permanent water holes, and contact was made with people at such points, to explain disease control and discourage the practice of feeding cysts to dogs. However, this period is more stressful for the population – not only are food supplies at their lowest but animals have to be moved to and from water and grazing sites which become increasingly far apart as the dry season intensifies. So, although access to the population is easier, people are less ready to give their attention to matters that seem less urgent.

Dog-control programmes and drug administration programmes are not easily sustained and can require external aid. Although a low-intensity programme continues today it is felt that further reduction of the disease is in the hands of the Turkana themselves. If dogs are not fed cysts they will not become infected with the adult worm and will not produce the eggs which then infect humans and domestic animals. If cysts in the viscera of livestock are identified and destroyed this would prevent transmission of the disease and, over time, eradicate it.
When does a pet become a health hazard?

Marcelo de Menezes Brandão & Marilia Anselmo Viana da Silva Berzins

Possibly the most important factor in the control of zoonoses is education, mainly directed at children, since they will spread the message to older people about sensible care for pets and good hygiene.

It is essential that children are taught how to care for their pets and maintain good hygiene. Photo WHO/PAHO/C. Gaggero

M rs Maria, a childless widow aged 75, lives in a small three-roomed house in a suburb of São Paulo. She shared her home with 32 cats until neighbours called the Centre for Control of Zoonoses to complain of the bad smell. The cats roamed in other people's houses looking for food; most of them had skin diseases such as scabies, and several lay dead inside her home. After some discussion, most of her pets were sent into the care of the Animal Protection Associations, with the owner's agreement, but she was permitted to keep several of them, and these were very soon restored to good health. The area where the cats lived was completely cleaned and the house is once again spick and span. Feline overcrowding no longer poses a health risk to Mrs Maria and her neighbours.

This little episode is just part of our centre's daily routine. São Paulo is the biggest city in Brazil, the second largest in Latin America and by some reckoning the third largest in the world. Its 10 million inhabitants come from all parts of Brazil and from many other countries to live in an area of 1500 square kilometres. Not surprisingly, the city has a great many social and economic problems, since many areas have poor housing, few schools, high unemployment, and often inadequate public transport. Yet it is the principal consumer market and provider of services in Brazil.

The city's Centre for Control of Zoonoses was created in 1973 under the City Office of Health, and its principal task was the control of rabies - the frightening disease transmitted from rabid animals to humans, for whom it is almost invariably fatal. At that time there was a serious epidemic of animal rabies in the city, with frequent human victims too, so the Public Health Office launched a major control campaign. Years of hard work rounding up stray dogs and cats, vaccinating them and keeping them under surveillance at last paid off; since 1981 we have had no case of human rabies, and since 1984 no case of animal rabies.

International recognition

The Centre continues to keep a careful watch for any recurrence of urban rabies, but it is also engaged in the control of other urban zoonoses - diseases transmitted from animals to humans - such as leptospirosis and leishmaniasis. It is also responsible
for the control of insect vectors of diseases such as malaria and Chagas disease. Since 1985 we have been the National Reference Centre for urban zoonoses, and since 1994 a WHO Collaborating Centre - welcome confirmation that we have been nationally and internationally recognized for our professional training and research in new techniques of zoonoses control.

Pets mean companionship for a great many people in the city, especially when they have few social relationships. People give their pets names, share their food and even their beds with them. Pets become members of the family, with the big advantage that they offer humans unconditional affection, never criticize and are always present, in times of happiness or of sadness.

At our Centre we stress the importance of controlling zoonoses, but we also know that the association between human beings and animals has existed since the world began and it does not depend on social standing, wealth, intelligence or age. Unfortunately that association sometimes surpasses the bounds of common sense and can therefore pose public health risks. For example, we have been wrestling with the problem of a wealthy family who keep almost 400 dogs in their house with very poor standards of cleanliness and sanitation. The animals are born, live and die haphazardly within the house; they even eat each other - this in a smart residential area of São Paulo, despite constant complaints from neighbours.

Our Centre can only act within the laws and we often face long delays before judgement is given. Nor do magistrates give a ruling about where the animals can be sent, so we have to invest money and effort in solving such problems. This does not always give the neighbours the satisfaction they want!

Elderly owners

Brazil's population is ageing, as is that of other countries, so many of our duties concern people aged over 60 and their relationships with their pets. Many of these people have limited spending power, but may have up to 20 or even 100 animals (usually cats or dogs). They tend mostly to be single or widowed women living on their own.

Our medical and veterinary agents and social workers are always made welcome when they make house visits, and can usually resolve whatever problem has arisen. All pets have to be vaccinated and we try to reduce their numbers to a reasonable level. The hardest part is persuading these elderly owners to part with some pets which they often regard as family members.

Mr Agenor is 67 years old, has never been married and has no children. His life revolved around 18 cats and four dogs. Our visiting team, with the help of his cousin, persuaded him to let 12 of the cats be rehoused with friends, neighbours and Animal Protection Associations. He has kept the remaining cats and the dogs, all have been vaccinated and, after a few lessons in pet management, he continues to live happily with his companions.

While we know the need for control of zoonoses, we are aware that the most important factor is education, mainly directed at children. It is they who can most easily sow the seeds of sensible caring for pets and good hygiene. The Centre for Control of Zoonoses has invested heavily in education, as we seek to help people to understand what keeping pets and other animals really entails in order to avoid health hazards. Our activities also serve to reduce the number of cats and dogs abandoned to fend for themselves in the city streets.
Zoonoses and the immune system

Ashley Robinson

The benefits of pet ownership can outweigh the risks of infection, provided that common-sense pet care guidelines are followed.

Many people today have a weakened immune system as a result of chronic infection or because they have received powerful drugs during cancer treatment or have undergone organ transplants. The problem is set to become more acute in the future as the proportion of elderly people, who are more likely to develop cancer than young people, continues to grow. Naturally, anyone suffering from a disorder of the immune system must take care to avoid unnecessary exposure to disease, but to what lengths should they go? Should they, as some have suggested, part with their pets or change their job if it involves potential contacts with zoonotic agents?

Pets and the sick: a dilemma

"People come to visit but they can only stay an hour or so and then they have to leave. My cat, she's always there". These words from an HIV-infected person point to a dilemma faced all too often by people whose immune system may be failing to make the normal response to the many infectious agents encountered in daily activities.

Well-meaning friends, health care providers and even physicians may advise those infected with HIV or suffering from other immune disorders to get rid of their pets because they are potentially a source of disease. However, recent studies in the USA have shown that there is little difference in the levels of pet ownership between the HIV-infected and the rest of the population. This suggests that, to a large extent, the advice is being ignored, probably because for many the unconditional affection and companionship offered by pets are hard to do without.

When people fall sick, or are unable to work, when even their best friends may desert them, the psychological benefits of pet ownership may often outweigh the risks of acquiring a zoonotic infection. In view of the dilemmas that can arise, it is important to know what the real dangers are and what steps can be taken to minimize them.

The major zoonoses that HIV-infected and other immunodeficient persons acquire are:

(a) Enteric (intestinal) infections that may result in life-threatening diarrhoea such as salmonellosis, campylobacteriosis, and cryptosporidiosis. These infections are most likely to be either water-borne or acquired indirectly through food. On occasion, however, they are acquired directly from animals, especially if these have diarrhoea.

(b) Systemic infections which involve the body as a whole. Toxoplasmosis, tuberculosis, cryptococcosis, Q fever and cat scratch fever are all examples of this type of infection which may lead to encephalitis (inflamma-
Pet selection and animal handling guidelines for the immunosuppressed

1. Before purchasing a new animal, contact a veterinarian for information and help. It is best to avoid stray animals as well as puppies, kittens, reptiles and monkeys; these are more likely to carry infections. Neutered animals (castrated or spayed) are safer as they are less likely to roam.

2. Domestic animals have their own immunodeficiency viruses such as the feline leukaemia virus. As a result, infected animals can be at greater risk than others of acquiring zoonotic infections. Cats, for example, should be tested and, if negative, vaccinated before adoption or purchase. Animals can also be tested for zoonotic infections before purchase, but a negative test is no guarantee that a subsequent infection will not occur. Measures to avoid infections are likely to be more effective in the long run.

3. After purchase, keep the animal healthy and clean, as sick animals are more likely to spread infection via faeces, urine or saliva. Consult a veterinarian for diagnosis and treatment, as well as ensuring that the appropriate vaccinations are given.

4. Feed pet animals and birds the pet foods available in shops, or cooked foods. Do not feed them raw or undercooked meat or eggs, or unpasteurized milk, and do not let animals drink from a toilet.

5. As a general rule keep animals indoors; when outside, keep them on a leash or tether.

6. Keep animals free of parasites, including fleas and ticks, and keep their sleeping and feeding areas clean.

7. Keep claws short to avoid scratching. In extreme cases the claws can be removed entirely. Animal-inflicted injuries should always receive immediate first aid, and a doctor should be consulted.

8. Always wash hands thoroughly after handling animals and wear disposable gloves when cleaning up faeces or vomit or when disposing of litter. The agent Toxoplasma gondii takes about 48 hours to become infectious in cat faeces, so litter should be removed daily. Similar precautions should be taken when working with livestock, and care should be exercised when dealing with animals which have diarrhoea (particularly when they are young) or when handling animals that have recently been aborted.

A helping hand

In some places, local organizations have been formed to provide information and assistance to HIV-infected pet owners. Volunteers can be of enormous help: they can change litter boxes, clean fish tanks and bird cages, walk dogs, assist with flea control in the home, take care of pets when the owners are hospitalized and, if necessary, arrange for their adoption.

In conclusion, pets can be good for our health and emotional well-being. For those with immune disorders, the benefits of having pets can be especially important. Providing that common-sense guidelines are followed there are no significant reasons why these benefits should be denied.

Dr Ashley Robinson is Professor and Clinical Epidemiologist, Middle East Regional Cooperation Project, Tufts University/School of Veterinary Medicine, 200 Westboro Road N, Grafton, MA 01536, USA.

The September-October issue of World Health will report (on page 28) on the 8th International Conference on Human-Animal Interaction on “The changing roles of animals in society” (Prague, September 1998).
Diseases transmitted by pets
Bruno B. Chomel

Animals have always played an important part in our societies as a source of food, labour and companionship. In most industrialized countries, more than one household in two reports owning a pet of some kind, with dogs, cats and birds being by far the most common choices. Recently, however, in a trend which is particularly marked in North America and western Europe, people have begun choosing pets from a wider range of species. These include not only small rodents and ferrets, but also reptiles, pot-belly pigs and even bats.

There exist more than 150 infectious or parasitic diseases which can be transmitted from vertebrate animals to humans. Those highlighted here are mentioned either because they are extremely severe, especially in children, or because they are very common, though often underreported.

Transmission by bites and scratches

Dogs and cats can be a source of several major zoonotic diseases. Among these, rabies is certainly the most feared, as it is always fatal in patients who do not receive treatment. It is estimated that every year more than 50,000 people worldwide die of rabies. The bite of any pet in countries where rabies is endemic in dogs or wildlife should be reported to the health services, and the animal responsible should be placed in quarantine for at least ten days.

Dogs remain the major threat; in recent years, several reports from areas in which dog rabies is endemic have emphasized the role played by very young rabid puppies in human infection. Over the last few decades, post-exposure treatments for rabies have been greatly improved and modern vaccines should now be made more accessible and less expensive in the developing world, where humans are most at risk from rabies. In addition, mass rabies vaccination campaigns aiming at a coverage of at least 70% of dogs, the application of leash laws and the placing in quarantine of animals responsible for bites are essential to ensure that human infection is reduced.

Another disease associated with dog and cat bites is pasteurellosis. This bacterial infection, caused by Pasteurella multocida, is characterized by a sharp pain where the bite was received, which the victim only starts to feel some hours after being bitten. The pain is accompanied by redness and swelling, and sometimes the lymph nodes become enlarged. If not treated with appropriate antibiotics (penicillin or amoxicillin, for example), this infection can lead to severe complications such as tendon or bone destruction. Pasteurellosis infections are particularly common following cat bites.

Cat scratches are also a source of human infections, especially in children and teenagers exposed to young kittens. "Cat-scratch disease", caused by a recently identified bacterium, Bartonella henselae, is typically a benign, subacute, regional lymphadenitis (inflammation of the lymph nodes) in which the agent responsible is introduced through the skin. In people whose immune system has been weakened, it causes bacillary angiomatosis, a life-threatening vascular disease in which tumours are formed from blood cells. Domestic cats may be healthy carriers of the organisms and can be infected for up to several months. The disease is transmitted from cat to cat primarily by fleas; as a result, flea-infested stray cats are more likely to be a source of human infection.
**Other modes of transmission**

In countries where plague (caused by *Yersinia pestis*) is endemic, free-roaming pet cats can become infected or carry infected rodent fleas that pass the disease on to humans. Cats are very susceptible to plague and develop bubonic, pneumonic and septicaemic plague. Several human cases of bubonic and pneumonic plague in the USA have been associated with exposure to pet cats.

Most diarrheal and gastrointestinal illnesses are acquired through consumption of tainted food items, but pets, too, can carry infectious agents, such as *Campylobacter* or *Salmonella*. Puppies or kittens with diarrhoea pose the greatest zoonotic risk. It should be common sense to prevent infection by washing one's hands after contact with pet animals and prior to eating.

Reptiles are carriers of a wide range of *Salmonella* species. Recently, many more iguanas have been purchased as pets, particularly in the USA, and this trend has been characterized by several severe, even fatal, *Salmonella* cases in young children. Pet turtles also are a major source of *Salmonella* infection, causing outbreaks in many countries worldwide.

Pet rabbits are rarely a source of zoonotic diseases. Rodents, on the other hand, transmit a wide range of viral infections, including hantavirus. This is a serious disease which produces flu-like symptoms together with kidney deficiency, or even kidney failure. This disease can also cause an acute respiratory distress syndrome. Another acute viral infection which can be very severe in children is lymphocytic choriomeningitis (LCM), leading to a flu-like illness followed by neurological symptoms, such as aseptic meningitis. In both the USA and Germany, outbreaks of LCM have occurred in children contaminated by pet hamsters. Outwardly healthy rodents can be carriers of the virus. In any case, it is important to remember that non-domesticated rodents should not be kept as pets.

Parasitic infestations are common in young pets. Cats are the definitive hosts of the agent of toxoplasmosis, *Toxoplasma gondii*, which is a common infection in humans, especially in developing countries or countries where meat is traditionally consumed undercooked. Most infected persons may not show clinical signs, but if women are infected during pregnancy, this can result in abortion, stillbirth, or congenital defects such as mental retardation. Pregnant women should either not clean cat litter boxes at all or do it every day to prevent the *Toxoplasma* eggs from maturing. In developing countries, puppies and kittens may be heavily infested with roundworms (*Toxocara canis* or *T. cati*) that they shed into the environment. Young children who are playing outside may be infected by ingesting eggs present in the soil or on contaminated hands or other objects. One of the complications of these infections is ocular larva migrans which causes strabismus, failing vision and eye pain. There are two main preventive measures: pets should be dewormed regularly, particularly when young; and they should be prevented from defecating in sandboxes where children may play.

Pet birds, especially psittacines (such as parakeets, cockatiels and budgerigars) frequently harbour *Chlamydia* organisms, shedding them in their faeces and spraying them as aerosols. Humans acquire psittacosis by inhalation of infectious aerosols. The disease is an atypical pneumonia with fever, headaches, muscle pain and shortness of breath accompanied by a non-productive cough. Treatment is based on the use of antibiotics, such as doxycycline, and in industrialized countries most imported psittacine birds receive a preventive antibiotic cure for three to four weeks.

In summary, people need to be aware of the health risks associated with pet ownership, but it should be emphasized that zoonotic diseases are usually quite rare. Owners who look after their pets properly, ensuring that they are well nourished, correctly vaccinated and regularly examined by a vet, should have little to fear.

Dr Bruno B. Chomel is Associate Professor of Zoonoses, Department of Population Health and Reproduction, School of Veterinary Medicine, University of California Davis, Davis, CA 95616, USA.
Dogs and Aboriginal health in Australia

Bart Currie

Living in a remote Aboriginal community in Australia, this dog carries the disease scabies, which puts young children at special risk. Photo B. Currie ©

The question in any community where dogs interact with humans is the degree to which infections and related nutritional problems are the result of dog-to-human interaction rather than human-to-human interaction or human interaction with the rest of the local environment.

Mortality rates in the 20–40 year age group are up to 10 times higher for Aboriginal people than for other Australians, and life expectancy is 10–20 years lower.

There are many remote Aboriginal communities scattered across central and northern Australia. These communities have populations ranging from less than 100 to a few thousand, frequently living in harsh conditions. Overcrowding is common, and sometimes 20 or more people may share a single house with a poor water supply and inadequate sanitation.

Dogs, disease and humans

Dogs are often numerous in Aboriginal communities. They live in a semi-domesticated existence, scavenging for food around the houses and defecating nearby. The relationship between people and dogs is partly one of companionship but involves other more complex cultural factors.

Since the mid-1980s a range of “dog programmes” have been introduced in Aboriginal communities in order to limit the size of the canine population and improve its health. Various combinations of dog control and treatment have been applied, including dog sterilization, contraception, “euthanasia” and the use of anti-parasitic drugs. For a number of reasons the programmes have not always had a particularly unified character: sometimes they have been set up at the behest of the local community, sometimes not; funding has come from a variety of government and non-government sources; implementation has often been on an ad hoc basis and sometimes the initiatives have not been maintained. Indeed, there was actually an increase in dog numbers following certain earlier programmes which failed to tackle dog population control.

The more sustained programmes with better funding and planning have clearly brought about a substantial improvement in the health of dogs in Aboriginal communities. What remains unclear, however, is whether these programmes have had any significant impact on human health. It was initially hoped that the dog programmes would prove particularly beneficial to the health of children because of their close contact with dogs, but this has yet to be confirmed. Concerns have been raised that the assumption that dog programmes improve children’s health could be used to justify redirecting health resources away from child health programmes towards dog health programmes.

There are a number of bacteria, viruses, fungi and parasites that can be transmitted from dogs to humans. The question in any community where dogs interact with humans is the degree to which infections and related nutritional problems are the result of dog-to-human interaction rather than human-to-human interaction or human interaction with the rest of the local environment.

The classic zoonoses transmitted from dogs to humans are hydatid disease (from a dog tapeworm),
which causes cysts in the liver and elsewhere, and toxocariasis (from dog and cat roundworms), which causes parasites to collect particularly in the liver and behind the eye. Hydatid disease does not occur in most of central and northern Australia, and cases of toxocariasis are very rare. Less important but well known zoonoses include a dog lungworm and dog hookworm. Lungworms, which are transmitted by mosquitoes, occasionally cause lung nodules in humans. Dog hookworms, which hatch from dog faeces, produce a migrating itchy skin lesion in humans as their larvae attempt (unsuccessfully) to penetrate beyond the inoculated skin of their host in order to enter the bloodstream.

Recently, gastrointestinal and skin infections have been the focus of research into potential zoonotic transmissions from dogs to humans. Transmission of gastrointestinal infections is usually faecal-oral via contaminated food, water, hands, utensils or soil. Flies, too, facilitate the transmission of certain bacteria. Some gastrointestinal parasites such as human hookworms and strongyloides (nematode worms) are transmitted from faeces to the skin via the soil. Skin bacteria and scabies parasites are transmitted directly from skin to skin. For both diarrhoeal disease and skin disease, extensive epidemiological studies have shown that the most important factors for transmission are household overcrowding, poor sanitation and an inadequate water supply. International experience suggests that in disadvantaged Australian Aboriginal communities there will be a high level of human-to-human transmission of infectious diseases. The unknown quantity is the additional burden of infections represented by dog-to-human transmission.

The role of human-to-human transmission has been firmly established for the major microorganisms causing diarrhoeal diseases, including those transmitted indirectly via contaminated food products and water. However, the role of potential zoonotic infections from dogs has only been adequately documented for a few organisms such as Campylobacter (which can cause gastroenteritis) and certain strains of Salmonella. Even in the case of Campylobacter and Salmonella, however, transmission from dogs represents only a small proportion of the total. There has been considerable interest in whether the Giardia parasites found in dog faeces are similar enough to those in humans to be transmitted zoonotically. Preliminary molecular genetic studies suggest that the cycles of transmission of Giardia in dogs and humans may not actually overlap to a significant degree.

The major skin infections in Aboriginal communities are skin sores (streptococcal), tinea (ring-worm fungus) and scabies. In the case of skin sores, the streptococcal bacteria involved are different for dogs and humans. The fungus responsible for nearly all the skin and nail tinea in Aboriginal communities is specific for humans, unlike some of the tinea fungi seen in southern Australian cities, which are zoonotic from cats and dogs. The animal variants of the scabies mite are generally restricted to animal hosts, and recent molecular genetic studies suggest that the vast majority of cases of scabies in the current epidemic in Aboriginal communities are unrelated to cycles of transmission of the dog scabies mite.

**Hard choices**

International experience has provided a wealth of evidence on the role of human-to-human infection in the transmission of diarrhoeal and skin diseases. While many Aboriginal communities have large numbers of dogs (many of them unhealthy) living in close proximity to people, the contribution these dogs make to the infections and related nutritional problems of the community remains unclear. Hard choices have to be made in the light of financial constraints and competition for public health resources, and it should therefore be remembered that child health programmes remain a priority. Routine community-based deworming, coordinated scabies programmes, and education initiatives must come before dog programmes. The issue of unhealthy dogs should not be pursued at the expense of the essential components of community health, such as adequate housing, water supply and sanitation. However, given the considerations outlined above, dog programmes in addition to child health and health infrastructure programmes could provide some benefits to humans.

**Dr Bart Currie is Associate Professor and Head of the Clinical Unit, Menzies School of Health Research, Darwin, PO Box 41096, Casuarina NT 0811, Australia.**
Keeping foods of animal origin safe

Fritz K. Käferstein & François-Xavier Meslin

Foods of animal origin constitute a certain proportion of most people's diet. Food animals help to sustain human life, but there is a negative aspect: a number of diseases can be directly transmitted by contact with animals (living or dead), or indirectly by eating such foods as eggs, meat, poultry, fish, shellfish and dairy products. Indirect transmission of disease can occur in two ways: foods may serve as a medium which allows bacterial pathogens to grow, or they may merely act as a passive vehicle of pathogens (as occurs with parasitic and viral diseases).

Many bacterial diseases due to microbes originating from food animals have emerged during the past 20 to 25 years. Inappropriate hygienic practices at animal husbandry, slaughterhouse and food processing levels are some of the factors which facilitate the multiplication and spread of these bacteria in food. Outbreaks of disease in humans are then all too likely. Non-typhoid Salmonella and Campylobacter are the two most important organisms in this context. Salmonellosis in particular has increased tremendously over the past two to three decades, in many cases due to an emerging serotype called Salmonella enteritidis. Poultry meat, eggs and food containing eggs are often the predominant sources of this pathogen. Multidrug-resistant Salmonella and Campylobacter are the two most important organisms in this context. Salmonellosis in particular has increased tremendously over the past two to three decades, in many cases due to an emerging serotype called Salmonella enteritidis. Poultry meat, eggs and food containing eggs are often the predominant sources of this pathogen. Multidrug-resistant Salmonella typhimurium DT104 has been linked to poultry, a variety of meats and meat products, and unpasteurized milk. Campylobacteriosis has increased so much over the last 10 to 20 years that it is now the leading foodborne disease in several industrialized countries; again, the main vehicles for its transmission are poultry and unpasteurized milk.

Another emerging pathogen which is frequently transmitted by food of animal origin is enterohaemorrhagic Escherichia coli (especially E. coli O157:H7). First identified in 1982 in the USA, this organism has caused serious outbreaks in several parts of the world, and beef has often been the vehicle of transmission. The largest reported outbreak so far, in Japan in 1996, affected more than 9500 people (mainly schoolchildren) and caused 11 deaths, this time probably as a result of eating radish sprouts. A particularly dangerous pathogen, it affects the kidneys in about 10% of infected patients, leading to the life-threatening haemolytic uraemic syndrome.

Examples of parasitic and viral diseases which are transmitted by foods of animal origin include:

- toxoplasmosis (caused by a protozoa), trichinellosis (caused by a nematode parasite) and cestodiasis (a tapeworm) infection, as a consequence of eating raw or undercooked meats;
- nematodiasis and trematodiasis (caused by a parasitic fluke), as a consequence of eating raw or undercooked fish or shellfish;
- viral hepatitis A and E, through eating raw or undercooked shellfish.

Human infections caused by foodborne parasites or viruses are very common. Toxoplasma gondii in women, for instance, affects three out of every 1000 pregnancies, resulting in fetal death, prenatal morbidity or chronic infections. As for trematodes, more than 10% of the world's population are thought to be at risk of being infected. In 1988, a huge outbreak of hepatitis A in Shanghai, China, affected just under 300 000 people who had eaten molluscan shellfish (cockles).

Public health authorities are also concerned about food of animal origin which contains certain chemical contaminants, whether of environmental origin or used as veterinary drugs to treat or protect farm animals. Mercury is one example of an environmental contaminant; while it is a normal constituent of the aquatic food-chain, contamination of water has led to high, toxic concentrations of mercury in shellfish, resulting in serious risks to human health. Drugs used in veterinary medicine and animal husbandry, if not administered under approved conditions, may lead to unwanted residues in food of animal origin and therefore pose health hazards.

Marine biotoxins such as scombrotoxins, ciguatoxins and phyco-
toxins form another category of chemical contaminants which may cause poisoning in people who eat fish. In many countries this is a major public health problem, affecting thousands of people annually.

Whatever the pathogen or vehicle of transmission, the key means of preventing and controlling biological foodborne hazards are:
- prevention of contamination of food;
- prevention of the growth of (bacterial) pathogens;
- prevention of the spread and survival of pathogens.

These imply three main measures of protection from foodborne diseases.

### Three measures of protection

Firstly, the hygienic quality of raw foodstuffs at the production level must be improved. Although producing completely pathogen-free milk, meat, poultry and eggs is possible experimentally, its application on a large scale is not yet feasible. However, by applying the principles of good agricultural as well as animal husbandry and health practice, and by improving the environmental conditions under which animals are raised, the hygienic quality of such raw food products can be improved and specific pathogen-free products (e.g., free of *Brucella*, *Mycobacterium bovis*, *Cysticercus* spp, etc.) can be produced. The quality of water in which fish and shellfish are grown must also be safeguarded; provided it is not contaminated with human or animal faeces, the harvesting of products free from pathogenic bacteria and viruses is possible. Even so, it is not possible to exclude certain parasites, such as nematodes.

Secondly, food-processing technologies should be applied to prevent the spread and survival of pathogens in food. Pasteurization, sterilization and irradiation contribute to food safety by reducing or eliminating pathogenic microorganisms. In countries where milk pasteurization is widespread or compulsory, it has been possible to prevent many diseases transmitted through milk. Poultry remains a common source of salmonellosis and campylobacteriosis. It is possible that, in the near future, irradiation of meat and poultry products will play a similar role to that of pasteurization of milk, although its application on a large scale is not yet feasible.

The third and last line of defence is the most critical, and should protect the health of consumers even if the other two fail. This is the education of food-handlers in the principles of safe food preparation. These include professional cooks, persons handling food in catering establishments (including street-vendors), and those in charge of preparing food at home. The education of food-handlers is vital because, in most cases, foodborne diseases stem from:
- insufficient cooking of food or reheating of previously cooked food;
- preparation of food several hours before it is eaten, combined with inadequate storage;
- use of contaminated raw food;
- cross-contamination in the place where food is prepared;
- preparation of meals by infected or colonized people.

These three measures of protection equally apply to the prevention of chemical poisoning in food. Here, however, the role of food-handlers is much more limited and a bigger role must be played by industry and the food control authorities.

Every effort should be made to educate those responsible for preparing food for the family, since cases of foodborne disease are frequently due to mishandling of food in the home, as a result of negligence, ignorance or ingrained traditions and habits. Women in particular should be targeted as they are the ones usually responsible for feeding infants and young children, who suffer high rates of sickness and death caused by foodborne diarrhoea. Educating children in schools should also be recognized as an effective means of communicating to parents the concept of food safety and implanting the principles of safe food preparation in the minds of future adults.

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Dr Fritz K. Käferstein was formerly Director of WHO's Programme of Food Safety and Food Aid. Dr François-Xavier Meslin is Chief of the Zoonotic Diseases Unit in the Division of Emerging and Other Communicable Diseases Surveillance and Control, World Health Organization, 1211 Geneva 27, Switzerland.
Animal-to-man transplants

Clara J. Witt & François-Xavier Meslin

Transplanting organs and tissues from one person to another is now an almost commonplace practice for treating a variety of medical conditions. Removing the heart from a recently dead accident victim and using it to replace the diseased heart of another person was first successfully achieved in 1967. Today, heart, heart-and-lung and kidney transplants and grafts of other organs taken from donors—alive or recently dead—are routinely carried out by major hospitals around the world. Unfortunately, donations of organs have not kept pace with demand. In France in 1994, for example, 1627 renal transplants were performed, but there were approximately 4500 individuals on waiting lists for donated kidneys.

As an alternative to human donation, scientists are now investigating the use of animal tissues and organs. This is called xenotransplantation, from the Greek term xenos, meaning strange or foreign. Non-human primates such as chimpanzees have immunological similarities to humans, but potentially higher risk of disease transmission, as well as animal welfare and conservation concerns, argue against their use. Currently pigs are thought to be the animals most likely to be suitable for xenotransplantation because of the similarity of their organ size and anatomy to those of humans.

The principal risk with any transplant, whether from human donors or from animals, is that the imported organ or tissue will be rejected by the new host’s immune defence system. Hyperacute rejection, for instance, occurs within minutes of xenografting and can lead to death in the patient. Researchers are trying to overcome such rejection by masking the “foreignness” of grafts in their new hosts. Successful clinical trials have already used antibody-treated fetal pig neurons (a masking technique to trick the host body) as a means of treating patients with Parkinson disease, and transgenic pigs have been specially bred whose cells express more human-like proteins.

A United Kingdom report on the use of animals to produce organs for transplantation commented that “some degree of genetic modification is ethically acceptable providing that there is a concomitant benefit to humans and that the pig neither suffers unduly nor ceases recognizably to be a pig.” Researchers are also acutely alert to the risk of any known or unknown infectious agent passing to humans from transplanted cells, tissues or organs of porcine origin.

Transplants of organs from human donors are now commonplace, but there is a critical shortage of potential donors. So scientists are assessing the risks and benefits of using cells, tissues and organs from specially bred animals to replace diseased organs in human patients.

The ethical dilemma

Beyond the purely medical problems important issues of public perception of xenotransplantation, since the use of animal transplants could conflict with people’s beliefs or ethical norms. While some people might welcome this technology as a demonstration of modern medical capability, others might utterly reject the notion of receiving organs from another species. In some religions it is seen as wrong to accept human-to-human transplants.

In October 1997, WHO invited 25 specialists from different disciplines, including microbiology, immunology, veterinary science, ethics, religion and law, to a Consultation on the feasibility and acceptability of xenotransplantation. They agreed that this technique “holds potential for clinical applications” and considered that the use of transgenic, cloned or otherwise genetically modified animals as a source of cells, tissues or organs was acceptable, as long as the health of humans was protected, human dignity was respected, and animal welfare and identity were maintained. They added that “public acceptance should not be assumed,” and stressed that policy-makers in this field must take account of people’s ethical, social and religious perceptions and attitudes, as well as each nation’s legal norms.

Dr Clara J. Witt, a veterinarian specializing in preventive medicine and laboratory animal science, is currently working for the Bacterial Diseases Unit and Dr François-Xavier Meslin is Chief of the Zoonotic Diseases Unit, both in the Division of Emerging and other Communicable Diseases Surveillance and Control, World Health Organization, 1211 Geneva 27, Switzerland.
WHO publications

Publications can be ordered from Distribution and Sales, WHO, 1211 Geneva 27, Switzerland.

Combating a brutal practice

Female genital mutilation has been practised for more than 2000 years. At least 130 million women and girls alive today have undergone the procedure. Yet although female genital mutilation (sometimes called female circumcision) is so common in some parts of the world—and leads to serious health problems—little is known about it outside the communities where it takes place. Female genital mutilation—an overview provides the information needed to understand both the social importance of the practice and the dangers it presents to the women and girls who undergo it. The book explains what the different types of female genital mutilation involve, what mental and physical complications result, and what research needs to be done to put an end to the practice.

Female genital mutilation—an overview does not make for easy reading. It describes a brutal and humiliating practice that has been condemned by international agreements and national governments. The book makes clear why, for the sake of all the women at risk, female genital mutilation must be stopped.

Veterinary drug residues in food

Many animals are given drugs in varying quantities and for various reasons, but just what effect is there likely to be on humans who eat food that comes from those animals? The question can be worrying, and a joint expert committee of the Food and Agriculture Organization of the United Nations and WHO meets regularly to evaluate available data and make recommendations on maximum safe levels of veterinary drug residues in food.

The latest report of the committee evaluates data on a variety of veterinary drugs—antimicrobials, insecticides and others. Annexed to the report is a summary of the committee’s recommendations on these drugs, including acceptable daily intake and maximum residue limits for humans.


A guide to diagnosing rabies and developing vaccines

Laboratory techniques in rabies is a comprehensive guide to laboratory techniques for research and diagnosis in rabies and for the production of vaccine. The fourth edition of this standard reference work has been revised and expanded to take into account the latest experience worldwide.

The book has six parts. The first gives a general overview of current laboratory techniques and safety precautions, and summarizes the characteristics of the rabies virus. The second and third parts evaluate a range of different research and diagnostic techniques. The fourth and fifth parts deal with the production of rabies vaccine for use in humans and animals, and show how to assess the safety and potency of vaccines. The final part covers the production of antirabies serum and immunoglobulin for humans and horses. The annexes give a wealth of practical advice that includes the collection and transport of brain specimens and the calculation of vaccine potency. The book’s 40 chapters are written by world-renowned rabies researchers. It is fully illustrated for a clearer understanding of the techniques described.

Laboratory techniques in rabies, Fourth edition (ISBN 92 4 154479 1) costs Sw.fr. 115./-US $103.50 (Sw.fr. 80.50 in developing countries).

Bringing relief to the terminally ill

Incurable disease causes tens of millions of deaths every year. Although the situation is not likely to change significantly in the short term, much can be done to relieve the suffering that goes along with this kind of disease.

For the terminally ill, even small complaints cause suffering. A cough or a hiccup, which is little more than an irritation to the healthy person, can lead to considerable pain and discomfort in a patient with a serious illness. Symptom relief in terminal illness stems from the report of an expert committee on cancer pain relief and palliative care and addresses the need for guidelines on the management of symptoms other than pain—symptoms such as anorexia, anxiety, constipation, depression, nausea, and intestinal and urinary problems.

While many of the approaches to symptom relief involve the use of drugs, simple and effective non-drug measures are also described. The book stresses that family members and appropriate counselling can give invaluable support to the patient. Symptom relief in terminal illness complements WHO’s Cancer pain relief which is a bestseller that has been translated into more than 20 languages.

Symptom relief in terminal illness (ISBN 92 4 154507 Q) costs Sw.fr. 25./-US $22.50 (Sw.fr. 17.50 in developing countries).

In the next issue

The September-October 1998 issue of World Health will not be devoted to a single theme, but will present a variety of topics on WHO’s work of fighting disease and its social causes. There will be articles on mental health, the impact of lifestyles on health, men’s health, and gender differences requiring different approaches to disease control.
PIGS BEING HOSED DOWN WITH WATER PRIOR TO BEING TRANSPORTED TO THE SLAUGHTERHOUSE. RESPECT OF GOOD AGRICULTURAL, ANIMAL HUSBANDRY AND HEALTH PRACTICES THROUGHOUT THE PRODUCTION, HARVESTING AND PROCESSING OF FOOD FOR HUMAN CONSUMPTION CONTRIBUTES TO REDUCING THE RISK OF TRANSMISSION TO MAN OF DISEASES FROM ANIMAL ORIGIN.