New serious infectious diseases - recent history and current status

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Preface

The critical SARS epidemic is probably still fresh in everyone's mind, particularly as new cases continue to develop from time to time. Foot and mouth disease and swine fever are other well-known and dreaded diseases We believed that we knew how to deal with and prevent such diseases, but we have recently experienced massive outbreaks at close quarters.

Other new and deadly viral diseases, probably originating from wild animals, have led to massive epidemics in other animals species as wild animals colonise new sites close to humans and domestic animals, thus creating new infection pathways. Extreme tourism is a risk factor in this context. Forest fires, which can have their origins in global warming, have also been cited as a reason for animal displacement, for example of bats from Indonesia to Southeast Asia, with subsequent outbreaks of disease.

A common factor in many of these new diseases is that they have their origins in areas densely populated by animals and humans in Asia. What are the risks of these diseases spreading to Europe and then to Sweden? What is being done to reduce these risks?

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What is going on?

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A lot is going on regarding serious infectious diseases be it epidemics, epizootics and or zoonoses. The emergence is due to the appearance of new pathogens, introduction of pathogens in new ecologies/places, and/or the emergence of old pathogens after reinvigoration by incorporation new genes. Hence, the unexpected emergences of diseases are a part of normal life.

New pathogens - A microorganism might emerge in new pathway(s) and host(s). The origin of bovine spongiform encephalopathy BSE is somewhat ambiguous possibly appearing as undetected cases in cattle in the late 1970ties according to the BSE inquiry in the UK released 2001 (http://www.bseinquiry.gov.uk/report). However, it appears that changes in rendering practices i.e., lower temperature and pressures cessation of fat extraction with ether were important when the agent was recycled and transmitted by the use of meat and bone meal as feed additives. Currently the reasonable hypothesis of BSE originating from scrapie seems to have less support, while there is a possibility that BSE has been detected in goats. The concern with avian or pig flu virus is that it might recombined with human flu virus resulting in a human pathogenic flu virus with pandemic potential (de Jong et al, 1997). A bacterial example is enterohaemorrhagic Escherichia coli (EHEC) that emerged as a zoonosis originating from healthy ruminants, during the last 20 years with noteworthy features such as low infectious dose in humans and tolerance acidic environments (Mead and Griffin, 1998).

New virulence – New virulence, persistence or resistance genes enable bugs to emerge rejuvenated and being able to be transmitted along new pathways. Some 20 years ago it was the conventional wisdom that salmonella could contaminate the surface of a egg, but the intact egg, i.e., both egg yolk or egg white was sterile. The epidemic of Salmonella enteriditis PT 4 which could infect the eggs through the ovaries and appear in intact eggs (Humphrey, 1991 and 1998; Mawer, et al., 1991) was an example of the emergence of a new transmission path for bacterial public health treats. Eggs appear to still be the main source for human salmonellosis in EU currently (Kaesbohrer, 2004).

New place – If a pathogen is introduced into a place with ready to go vectors the results might be surprising. West Nile Virus (WNV) is such an example. From the introduction in 1999 in New York to today 2004 where WNV is spread all over USA apart from Alaska and Hawaii and some parts of Canada (http://www.cdc.gov/ncidod/dvbid/westnile/). In European Union the WNV is found in horses in the south of France (http://europa.eu.int/comm/food/fs/sc/scv/out67_en.pdf) while the disease appear to be stable. In the report from the EU scientific committee on veterinary public health measures (SCVMPH) it is suggested that for surveillance purposes of WNV risk horses might be useful sentinel animals.

New ecologies and antropogenic changes - An example of antropogenic change of the ecology that might enable new diseases to emerge is the domestication of new species for agriculture, aquaculture or leisure purposes. The domestication of Atlantic salmon (salmo salar L.,) in the aquaculture industry during the last 20 years was accompanied by the emergence of several epidemics. One example would be the infectious salmon anemia (ISA) epidemic in Norway during the 1980-90ties (Vågsholm et al., 1994). Typical for serious emerging diseases were that for several years the aethiological agent was not identified and no diagnostic test available. Thus both diagnosis and control measures were based on the clinical syndrome (e.g., anemia and anemia associated symptoms such as swimming close to the surface, high mortality and good appetite). Moreover, the need for syndrome reporting in the early stages of the emergence an infection that was also emphasized during the SARS epidemic (severe acute respiratory syndrome) (Koopmans, 2004).

New eating habits and technological changes in the food chain - For daily convenience buying a fresh sandwich and a bottle of water appears to be a healthy alternative for the double income no leisure time individual. For the convenience stores the prospect of long storage times for fresh sandwiches through cold storage, is a profitable feature of the trade. However, this unlocks a new transmission path for listeria monocytogenes causing human listeriosis. In cold storage (0-4 C^{o}), the normal bacterial flora is not able to grow at these low temperatures, while listeria monocytogenes with its ability to grow in cold storage temperatures (Farber & Peterkin, 1991) can reach concentrations above the infectious dose before the end of the cold storage period, while the food still appears to be fresh and wholesome (McLauchlin & Van der Mee-Marquet, 1998). The infectious dose for listeria monocytogenes infections are reported to vary between millions of c.f.u., per gram for healthy people with gastrointestinal symptoms, to hundreds to thousands of c.f.u., per gram for vulnerable groups (Anonymous, 1999).

Global trade and travel – could also result in the emergence of a zoonotic agent at a new place. People, animals and food can travel around the world in 48 hours instead of 80 days. This meant that SARS could spread to several countries before control actions were initiated (Koopmans, 2004). In the UK foot and mouth disease epidemic in 2001 the suspected origin - feeding of foreign contaminated meat scraps to pigs. While the frequent movements of animals such as sheep ensured that disease was disseminated widely in the country before the disease was diagnosed and control measures implemented (see http//:www.pighealth.com).

Changes in dietary habits – A trend is that people is the industrialized and the industrializing world are becoming fat wishing to stay thin and healthy. Obesity is a global epidemic with severe consequences in terms of dietary related diseases diabetes II, coronary and heart diseases (Stolley and Lasky, 1998). This is giving rise to new diets such as sprouted seeds with the result that several outbreaks involving bacterial pathogens e.g., verotoxogenic Escherichia coli (VTEC) O157:H7 (NACMCF, 1999a). The largest outbreak involved VTEC O157:H7 in contaminated radish sprouts, with over 6,000 infected people in Japan (Michino et al., 1999).

Microbiological analyses have shown that alfalfa seeds routinely contain high levels of microorganisms, including coliforms and faecal coliforms (NACMCF, 1999a; Taormina et al., 1999b). The source of pathogens can be seeds, contaminated water or workers. Bacteria like VTEC O157:H7 will multiply during sprout germination (NACMCF, 1999b) since conditions under which seeds are sprouted (growing time, temperature, moisture and nutrients) are ideal for bacterial proliferation (Feng, 1997; Taormina and Beuchat, 1999a). An increase of 100 to 1000 fold (Prokopowich and Blank, 1991; Feng, 1997) can occur and bacterial numbers may exceed 107 per gram without affecting the appearance of the product (Taormina and Beuchat, 1999b).

Although there has been several food scares such as BSE linked to meat consumption. However, there is some evidence of meat consumption actually increasing in certain countries. This is possibly parts due to the Atkins diet in which the consumer avoids carbohydrates that are easily and quickly digested while increasing the protein intake by increasing the meat consumption. In this case the risk of food borne zoonoses would increase linked to the higher intake of animal protein.

Wars and unrest leads to breakdown of veterinary and public health infrastructure, and often to habitat changes. Very often in areas with war or unrest resulting in large number of refugees, the consequences will include outbreak of cholera and typhoid epidemics (Stolley and Lasky, 1998). The rabies epidemic in Europe was established in Poland in infected foxes during the end 2nd world war (Thrusfield, 1995). It spread from Poland to most of central Europe during the years thereafter. It was only when vaccination of foxes became common that one managed to control the spread and at commence on regional eradication program (Aubert, 1994). However for the foreseeable future Any breakdown of the vaccination program will enable rabies to spread again and remerge in currently free regions.

Conclusions - serious infection(s) affecting animals, people or both (zoonoses), will emerge annually. Nevertheless, the emergence is unexpected and when, where, and whom is uncertain although certain anthropogenic risk factors are identified. This is a global problem requiring a global solution. Consequently, a global and rapid early warning system is needed. This will require collaboration between the relevant international bodies i.e., FAO, WHO and OIE.

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Recent outbreaks of Nipah virus in Asia

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Nipah virus is a recently emerged virus that remains relatively unknown (1). It is interesting to contrast the characteristics of the outbreaks caused by Nipah this year in Bangladesh to the characteristics of the avian flu outbreaks in Vietnam and Thailand this year. Both diseases have affected almost the same small number of people in Asia. Both diseases have a high case fatality ratio. Both diseases have an animal reservoir and are able to transmit from animals to humans as a zoonotic disease. No person-to-person transmission has been verified for avian flu, while in the latest outbreaks of Nipah person-to-person transmission accounted for most of the cases. Therefore, the most likely reason to why Avian flu has been on the headlines for this year and very few people have heard of Nipah is the fact Avian flu hit tourist areas in Thailand and Vietnam and Nipah hit one of the poorest countries on earth with little economic or tourist activity.

The outbreaks of this year were preceded by a series of outbreaks since 1998. After the discovery of a Hendra virus in Australia in 1994, a related virus was found to affect non-Muslim adult males in the northern parts of peninsular Malaysia in September 1998 (2). It turned out the affected population were workers from pig farms and the outbreak was rapidly spreading from farm to farm in Malaysia and finally to 11 abattoir workers in Singapore (3). Before June 1999 about 265 cases had been identified, out of which 101 had died. Within two years a similar disease was noted among young males in a northern village of Bangladesh, a predominantly Muslim country east of India. Similar clusters followed in 2003 and now twice during this year in Bangladesh, resulting in a total of 91 cases out of which 61 have died rapidly after onset of symptoms (4).

Nipah virus causes brain inflammation, encephalitis, in affected human beings, with symptoms of rapidly rising fever, headache and coma (often within 24-48 hours of onset). Dry cough, breathing difficulties and vomiting often accompany these symptoms. Symptoms appear 3-14 days after contact. The serologic diagnosis can be aided by magnetic resonance imaging of the brains, showing small lesions in sub cortical white matter. Most cases die within 6 days of onset.

The virus itself belongs to the family paramyxoviridae, where also the human measles and mumps viruses and the canine distemper and rinderpest viruses belong. In humans it affects mainly the small and medium sized blood vessels, and thereby most of the major organs also. In treatment the broad-spectrum antiviral has been beneficial in a open trial.

More evidence now exists that the reservoir of the Nipah virus is the fruit-eating flying fox or the Pteropus species. The virus has been found in the urine of this bat and in fruits partially eaten by it. Antibodies against Nipah have also been found in horses, dogs and cats. Transmission to humans has occurred from pigs in Malaysia and mainly from person to person in the 2004 outbreaks in Bangladesh.

The outbreaks in Malaysia with the pig-to-human transmission had a devastating effect on the local pig industry. Because of culling and export restrictions the size of the standing pig population in peninsular Malaysia decreased from 2.4 million pigs to 1.32 million, the number of farms decreased from nearly 1900 to only 800 farms and the direct economic losses were calculated to be 97 million US$ and loss of export 120 million US $. During the outbreaks the disease was transmitted between farms probably with animal transports and likewise exported also to Singapore. It is noteworthy, that the animal disease was not noticed before the human outbreak was investigated. No significant changes in morbidity or mortality in the pigs had been noticed.

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SARS and comparative studies on coronaviruses in animals and man

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Severe acute respiratory syndrome (SARS) is a new infectious life threatening form of a atypical pneumonia that emerged in Guandong Province in southern China in late 2002. According to the WHO, 8089 people in 29 countries were diagnosed with with SARS and 774 died until the outbreak were brought under control. By July 5, 2003 no further cases were detected and the global outbreak was declared over.

A previously unknown coronavirus was isolated from SARS patients and was termed SARS-coronavirus (SARS-CoV). The full length- genome of this virus was elucidated within weeks after the isolation of this novel pathogen.

Members of the Coronaviridae family are classified into three antigenic groups. The members of Group I are: human coronavirus 229E (HCoV-229E), canine coronavirus (CCoV), feline coronavirus (FCoV), porcine transmissible gastroenteritis virus (TGEV), porcine epidemic diarrhoea virus (PDEV); Group II: human coronavirus OC43 (HCoV-OC43), bovine coronavirus (BCoV), porcine hemagglutinating encephalomyelitis virus (HEV), rat sialodacryoadenitis virus (SDAV), mouse hepatitis virus (MHV); Group III: avian infectious bronchitis virus (IBV), turkey coronavirus (TCoV). It has been proposed that the SARS-CoV defines a fourth lineage of coronavirus (Group IV). However, more recently, it has been suggested that SARS-CoV may be an early split-off from the Group II lineage.

Coronaviruses are enveloped single stranded RNA viruses with large genomes. Their molecular biology and structure is intricate. The genomic and structural complexity reflects a complex interaction with the host.

In man, the coronaviruses have not been considered, before the outbreak of SARS, as infectious agents of great importance. Coronaviruses were mainly connected to mild respiratory and enteric symptoms, especially in young children. The veterinary importance of coronaviruses has however always been high. Porcine transmissible gastroenteritis virus, Infectious bronchitis virus and Bovine coronavirus cause serious diseases and large economical losses in production animals. Considering this, the veterinary institutes have performed intensive research on coronavirus detection, biology, genome structure and development of methods of protection.

In my presentation at this meeting I will try too review current knowledge about SARS and also briefly inform about research that has started in Sweden in a Formas research project, with the following aims: A) Development of improved diagnostic tests for SARS and related coronaviruses; B) Screening for the possible occurrence of further, unknown SARS-related coronaviruses in animals and in humans. C) Aspects of viral evolution and genomic stability of coronaviruses from various hosts, D) Pilot studies to develop a subunit coronavirus vaccine candidate.

Influenza type A in wild birds - prevalence, modes of transmission, consequences for animals and humans

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Because all known influenza A subtypes exist in the aquatic bird reservoir, influenza is not an eradicable disease; prevention and control are the only realistic goals. If people, pigs, and aquatic birds are the principal variables associated with interspecies transfer of influenza virus and the emergence of new human pandemic strains, influenza surveillance in these species is indicated.

A constantly mutating virus: Two consequences

All type A influenza viruses, including those that regularly cause seasonal epidemics in humans (H3N2 and H1N1), are genetically labile and well adapted to elude host defences. Influenza viruses lack mechanisms for the ”proofreading” and repair of errors that occur during replication. As a result of these uncorrected errors, the genetic composition of the virus changes as they replicate in humans and animals, and the existing strain is replaced with a new antigenic variant. These constant small changes in the antigenic composition of influenza A viruses are known as antigenic drift. This is true for mammalian influenza viruses. Phylogenetic analyses have suggested that in nature AIV appears to be in evolutionary stasis. Influenza viruses have a second characteristic of great public health concern: subtypes from different species, can reassort genetic materials and merge. The reassortment of RNA, antigenic shift, results in the creation of a novel subtype different from both the parental viruses. As populations will have no immunity to the new subtype, and as no existing vaccines can give protection, antigenic shift has historically resulted in highly lethal pandemics. For this to happen, the novel subtype needs to have genes from human influenza viruses that make it readily transmissible from person to person. Conditions for the emergence of antigenic shift have long been thought to involve humans living in proximity to domestic poultry and pigs. Because pigs are susceptible to infection with both avian and mammalian viruses they can serve as a ”mixing vessel” for the scrambling of genetic material from human and avian viruses, resulting in the emergence of a novel subtype. Recent events, however, have identified a second possible mechanism. For at least some of the AIV subtypes circulating in bird populations, humans themselves can serve as the ”mixing vessel”.

Human infection with avian influenza viruses: a time-line

The first documented infection of humans with AIV occurred in Hong Kong in 1997, when the H5N1 strain caused severe respiratory disease in 18 humans, of who 6 died. The infection of humans coincided with an epizootic of highly pathogenic AIV, caused by the same strain, in the poultry population. Investigation of that outbreak determined that close contact with live infected poultry was the source of human infection and that the virus had jumped directly from birds to humans. Rapid destruction of the entire poultry population, 1.5 million birds, reduced opportunities for further direct transmission to humans, and may have averted a pandemic. That event alarmed public health authorities, as it marked the first time that an AIV was transmitted directly to humans and caused severe illness with high mortality. Other AIV have recently caused illness in humans. An outbreak of highly pathogenic H7N7 AIV, in the Netherlands in 2003, caused the death of one veterinarian and mild illness in 83 other humans. More than 30 million birds where killed to the cost of several million Euros.

Of the 15 (16) AIV H subtypes H5 and H7

is of particular concern for several reasons. The subtypes can mutate rapidly and has a documented propensity to acquire genes from viruses infecting other animal species. Their ability to cause severe disease in humans has now been documented and laboratory studies have demonstrated that isolates from these viruses have a high pathogenicity and can cause severe disease in humans. Birds that survive infection excrete virus for at least 10 days, orally and in faeces, facilitating further spread at live poultry markets and/or by migratory birds.

The epizootic of highly pathogenic AIV caused by H5N1, which began in mid-December 2003 in the Republic of Korea and spread rapidly to and in other Asian countries, is therefore of particular public health concern. H5N1 variants demonstrated a capacity to directly infect humans in 1997, and have done so again in South East Asia in 2004. The spread of infection in birds increases the opportunities for direct infection of humans. If more humans become infected over time, the likelihood also increases that humans, if concurrently infected with human and avian influenza strains, could serve as the "mixing vessel" for the emergence of a novel subtype with sufficient human genes to be easily transmitted from person to person. This would mark the start of an influenza pandemic. The pandemic clock is ticking but we don't know what time it is. Based on historical patterns, pandemics can be expected to occur, on average, 3-4 times each century. The Spanish Flu, which caused an estimated 40 to 50 million deaths worldwide, was followed by pandemics in 1957 and 1968. There is an agreement that a new pandemic is inevitable and possibly imminent. Considering the world's high population density and the fast modes of travel the next pandemic could have apocalyptic consequences. The occurrence of pandemics is unpredictable.

Experience in the production of influenza vaccines is also considerable, particularly as vaccine composition changes each year to match changes in circulating virus due to antigenic drift. However, at least six months would be needed to produce a new vaccine, in significant quantities, capable of conferring protection against a new virus subtype.

Results from the Ottenby study

In order to know what subtype combination that will cross the species barrier and infect humans, it is of utmost importance to know which exist in the wild bird population. Studies have previously been done in North America but less is known about the Eurasian bird population. In the North American studies AIV was common in ducks, mainly Mallards (Anas platyrhyncos) and Teal (Anas crecca). Up to 60% of the juvenile ducks caught on fall migration was infected (Alexander et al, 2000). In shorebirds (Charadriiformes), however, the highest prevalence was in spring which could imply overlapping enzootic cycles. At Ottenby bird observatory situated on a major European flyway we have collected samples from a large number and a wide taxonomic array of birds in the last five years. It is apparent that ducks are important as AIV carriers in Western Europe too, and that the lion's share of birds i.e. passerines, are not competent reservoirs. In the fall of 1999 we sampled 2000 shorebirds, but none, in contrast to North American studies, were positive for AIV. This study will be finalized by the sampling from spring migrating shorebirds in 2004-06.

The duck trap at Ottenby was set up in the fall of 2002. To date more than 5000 samples from 4000 ducks have been collected. RT-PCR screening from 2002 shows about 20% of the migrating ducks are AIV positive on at least one occasion. From the PCR positive samples AIV could be isolated in 60%. By hemagglutination inhibition tests more than fifteen subtypes have been identified; including H5N2, and H7N7. Notable is the finding of twelve H7N7, and fifteen H5N2 of 200 AIV positive mallards. Notable is that the H7N7 virus was detected in the migrating ducks two-three months before the start of the poultry epizootic caused in Holland. All H7N7 were collected late in the season indicating a north-easterly recruitment area of the ducks. A few ducks were positive on one occasion, re-caught several times as negatives and subsequently re-caught as positives. This could be due to two subsequent infections. If it is the same virus it is indicating a "super-shedding" phenomenon that may be ecologically important. Otherwise, it would proof that heterologous infections do not give an immunological cross-protection. We will in one of our analyses give priority to testing samples like these.

In order to know what AIV subtype combination that have the potential to cross the species barrier and infect humans, it is of utmost importance to know which subtypes exist in the natural reservoir of the virus, in the wild bird population. Our results have so far "retrospectively" indicated the presence of AIV in mallards migrating through Sweden with subsequent epizootic and human pathogenic potential in Holland in 2003. As they can cause serious infections in animals and humans, a basic knowledge of the mechanisms underlying occurrence and spread, of bird borne zoonoses in general and AIV in particular will be very important for agriculture, veterinary medicine and human medicine. The need for a best guess for a coming pandemic virus is urgent. We believe that our project, using surveillance in the wild bird population to document patterns, which can be used to produce testable hypothesis about the processes at work, is a central part of this predictive work and an important part of the network building up an early warning system.

Avian influenza in Asia

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Highly pathogenic Avian Influenza (HPAI) virus (subtype H5N1) has circulated in several countries in East and South-East Asia since December 2003. Compared with previous outbreaks of HPAI, the current outbreak is unprecedented in its scale, geographical spread and economical consequences for the poultry production.

Infection with HPAI in poultry causes a severe, systemic disease that can approach 100% morbidity and mortality. However, even if it's suggested that all birds are susceptible to infection, some species are more resistant than others. For example, migratory waterfowl are usually asymptomatic reservoirs of Avian Influenza (AI) viruses.

The first report of high mortality in poultry due to H5N1 infection was from South Korea in mid December 2003. This was followed by reports of outbreaks in Vietnam, Japan, Thailand, Laos PDR, China and Indonesia. The spread of HPAI during the first months of 2004 was rapid and the infection had a disastrous effect on the poultry production. Up to March 2004, around 100 million domestic poultry either died from H5N1 infection or were culled to control the outbreaks. Some of the countries, mentioned above, successfully eliminated the infection. However, in late summer 2004, the spread of HPAI continued in some countries and also spread to others previously not reporting infection. As of the end of October 2004, outbreaks of H5N1 were reported from Vietnam, Thailand, Indonesia, Cambodia and Malaysia. Most of the affected countries are / were experiencing outbreaks of H5N1 for the first time, and in several of them H5N1 has been detected in almost all parts of the country.

Apart from consequences due to culling of birds, there is also a large impact on public health, most apparent in Vietnam and Thailand where human cases of H5N1 infection have been reported. As of the end of October 2004, there were 44 confirmed human cases of H5N1 infection. Of those, 32 were fatal (12 in Thailand and 20 in Vietnam), giving a case fatality rate of 73%. However, when comparing the extent of the outbreak in poultry with number of human cases it may be suggested that the virus not easily infects humans. Despite investigations, human-to-human transmission of AI virus has, so far, not been confirmed in the current outbreaks. But, as long as the infection is circulating in the poultry population, there is a risk of emergence of a new "reassorted" influenza virus strain having the ability to transmit between humans. Development of a new virus strain can occur if there is a co-infection by influenza viruses from birds and mammals in pigs or humans. In Vietnam, in the beginning of 2004, there was circulation of human influenza virus at the same time as H5N1 spread rapidly among the poultry. This constituted a risk of co-infection of different influenza viruses and development of a reassorted virus. Furthermore, many regions in Asia practise animal management that mix different animal species, for example pigs and domestic poultry, which may facilitate co-infection and development of a reassorted virus.

The main control strategy in poultry is culling of infected flocks. This involves proper cleaning and disinfection of facilities, products etc. to eliminate the virus on infected premises and prevent further spread. Following culling, proper sanitary disposal of culled birds is important to remove sources of infection. In some regions, for example in Vietnam, it was difficult to find areas suitable for disposal of dead birds, and they therefore had to be transported through areas free from infection to reach a place suitable for disposal. This constitutes risks for further spreading of AI virus to other areas, free from infection. Other important control measures are tracing and surveillance to determine the source and extent of infection, and use of quarantine and movement control to prevent spread of infection.

An important aspect in the culling procedure is to reduce the risk of human infection through occupational exposure, for example exposure of farmers, veterinarians etc, but also to control infection in health care settings. Human infection can be avoided by proper use of personal protective equipment; however, such equipment was sometimes scares, or arrived after culling had taken place. Simultaneously as culling of poultry is taken place, epidemiological investigations should be performed to understand the extent of the problem for public health. This includes, for example, epidemiological studies in families were human cases were identified, assessment of risk of human-to-human transmission and measures to strengthen laboratory capacities.

Even if outbreaks of HPAI have been seen previously, there are some unique features of the current outbreak of H5N1 in East and South-East Asia. The first feature is the concentration of poultry on back yard farms. In some of the countries experiences H5N1 infection, it has been estimated that around 80% of the poultry production is performed at smallholdings. This may constitute practical problems as regards implementation of control measures and surveillance. Secondly, the economic significance of poultry production in Asia is substantial. Appropriate culling may be difficult to perform, as many people in the region are dependent on production of poultry, both economically and as food supply. Thirdly, there's lack of control experiences in the region, as outbreaks of HPAI previously have not been seen in some of the affected countries. It happened that successful culling was followed by detection of newly infected farms in the same region. There is also lack of resources for compensation of farmers, which is important to ensure a good co-operation to stop the spread of infection. The last feature is the scale of international spread that is seen in the current outbreak. Never before have so many different countries been affected simultaneously and this has created new demands for national and international cooperation. For more information see www.who.int, www.oie,int , www.fao.int, and www.wpro.who.int.

Pandemic spread of genes coding for antimicrobial resistance

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At their first introduction during the 1940s, antimicrobials were regarded as 'miracle drugs' or 'magic bullets'. Antimicrobials seemed to be the ultimate solution to the problem of bacterial infections, and scientific attention shifted to other areas. Resistance soon emerged in important bacterial pathogens, but was initially countered by a steady appearance of new drugs. Over the last two decades the emergence and spread of multiresistant bacteria has accelerated, while at the same time the flow of new antimicrobials has been reduced to a trickle. The false sense of security of the earlier years has given way to serious concern.

A global problem

Mortality resulting from infectious diseases represents about one-fifth of all deaths globally (WHO, 2004). Acute respiratory infections are the leading killers, causing nearly four million deaths annually (Figure 1). Antimicrobial resistance is today limiting our ability to treat bacterial pneumonias, diarrhoeal diseases and tuberculosis. Drug resistance is also a problem in HIV/AIDS infections and malaria. All these diseases are most common in low-income countries where today the extra burden caused by resistance is likely to be highest as access to second and third line antimicrobials is limited. In developed countries, alternative treatments for, e.g., pneumococcal pneumonia may still exist and the burden of resistance is in those cases for the time being prolonged disease and increased treatment costs. On the other hand, where advanced medical care is available multiresistant bacteria roaming the hospitals are jeopardising medical procedures such as implants of prostheses, organ transplantations and chemotherapy for cancer. Resistance also affects animal husbandry in all parts of the world, as infections in animals with multiresistant bacteria are increasingly reported.

Epidemiology of resistance

A bacterium can acquire resistance in two distinct ways: through mutation(s) in the relevant

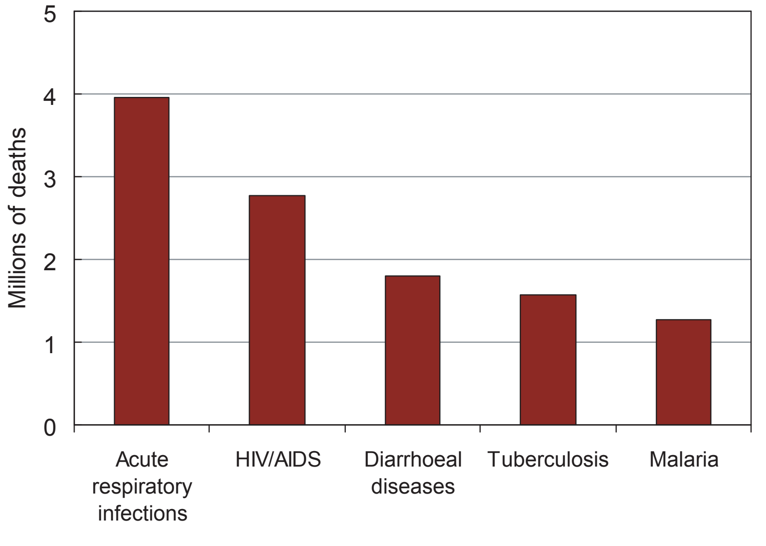

Figure 1. Global burden of mortality in infectious diseases, year 2002 (WHO, 2004).

gene or through uptake of copy of a resistance gene present in other bacteria. Resistance acquired through mutation will be confined to the mutant clone and emergence and spread will depend on the clone's ability to multiply and infect new hosts (vertical transmission). More common is uptake of resistance genes such as plasmids or transposons (horizontal gene transfer).

In an environment exposed to an antibiotic, susceptible bacteria will decrease in numbers while resistant bacteria will continue to multiply. In evolutionary terms, exposure to antibiotics exerts a selective pressure on bacterial populations. Plasmids and transposons may carry several genes coding for resistance, each to a different class of antibiotics. All the genes will be transferred in the same event and (co-transfer) and convey multiresistance.

Upon each treatment of a person or an animal, not only the pathogen but also the entire normal flora is exposed to antibiotics. Commensals, or even environmental bacteria, will act as a reservoir of resistance genes. Unless specifically looked for, this reservoir will go unnoticed until the resistance genes pass into clinically relevant bacteria.

The epidemiology of antimicrobial resistance is complex. Use and misuse of antimicrobials in all sectors will drive emergence and spread of resistance and is a major risk factor. All factors influencing the usage of antibacterials and/or the spread of infectious agents will also affect the emergence of resistance. In human medicine, such factors are; changes in human demographics and behaviour, changes in technology and industry, economic development and land use, international travel and commerce, microbial adaptation and change and breakdown of public health measures (Cohen, 1996). Most of these factors all influence the degree of contact between individuals, either by affecting the population density or by providing new contact routes. This emphasises the similarity between spread of resistance and spread of infectious diseases.

The fact that resistance epidemiology also has a molecular level (transposons or plasmids spread between bacteria) complicates the matter. Further, co-transfer of genes and reservoirs among commensals must be considered. Taken together, it is not surprising that the relation between antimicrobial use and resistance is not always clear-cut.

Pandemic spread of resistant clones

Day care centres provide ample opportunities for the transmission of infectious diseases and, in particular, the emergence of resistant Streptococcus pneumoniae. The combination of the presence of young, susceptible children suffering from recurrent infections and the use of multiple, often broad-spectrum antibiotics makes such environments ideal for the carriage and transmission of these bacteria (Melander et al. 1998). Resistance that emerges and spreads in such environments within a region or a country can easily be spread globally though travel and migration. A well-documented example of this is the spread of a penicillin-resistant clone of S. pneumoniae first identified in Spain. Soon, infections with the same clone were reported from Argentina, Brazil, Chile, Taiwan, Malaysia, the USA and Mexico (Smith & Coast, 2002).

Other documented examples of international spread of resistant clones involve pathogens such as Neisseria gonnorhoeae and methicillin resistant Staphylococcus aureus (MRSA).

Pandemic spread of resistance genes

Without prompt diagnosis and antimicrobial treatment, human plague is often rapidly fatal. Management of outbreaks, natural or through intentional release, depend on prophylactic treatment of the persons exposed. Such measures have led to a drastic decrease in plague worldwide, but the disease persists in endemic foci in Africa, Asia, North and South America. In 1995, a strain of Yersinia pestis resistant to multiple antibiotics, including all the drugs recommended for prophylaxis and therapy (chloramphenicol, gentamicin, streptomycin, sulphonamides and tetracyclines) was isolated in Madagascar from a 16-year old boy with clinical signs of bubonic plague (Galimand et al, 1997). Resistance was encoded by genes carried on a plasmid foreign to Y. pestis, but similar in structure to plasmids encountered in other enterobacteria. Transfer of the plasmid between Escherichia coli and Y. pestis easily occurred in vitro, and was later also demonstrated experimentally in the flea midgut (Hinnebusch et al, 2002). It was hypothesised that horizontal gene transfer in the flea-vector may generate multiply resistant Y. pestis. In this case, the strain apparently did not spread outside Madagascar but the potential for continued emergence and spread to other parts of the world is obvious.

The emergence and spread of the vanA-gene cluster, coding for vancomycin resistance, is an example of putative zoonotic and pandemic spread of a resistance-genes. Vancomycin and other glycopeptide antibiotics are used for treatment of hospital acquired infections with multiply resistant enterococci or staphylococci. In human medicine, the drug is used in situations where few or no alternatives exist. In animal production a related molecule, avoparcin, has been used for growth promoting purposes. Vancomycin-resistant enterococci (VRE) were first described in Europe, and within a decade they were among the most troublesome pathogens in hospital care in the US. Vancomycin resistant enterococci harbouring the vanA gene cluster have been isolated from humans, both in hospitals and community, from pigs, rabbits, dogs, cats, horses, chickens, turkeys, pheasants, ducks, food of animal origin and sewage (for a review see Bonten et al, 2001). The vanA gene cluster consists of 7 gene components and two transposition gene sequences. It is extremely unlikely that such a complicated gene should have developed separately in so many different host populations and localities. Through use of modern techniques the phylogenetic relationships of this gene cluster in bacteria isolated from various host species in different countries it has been clearly shown on a number of occasions that VRE from different animal species and humans in different countries can contain indistinguishable genetic elements coding for resistance (for a review see Bonten et al, 2001). Taken together, this indicates that the vanA-gene cluster has originated somewhere, perhaps in nature, has entered populations of bacteria colonising people and/or animals, been amplified and spread in to bacteria of other hosts in environments where antimicrobials are used, and evolved further in different localities and countries.

Problems and perspectives

Factors in modern society such as technical development of medical care, urbanisation and the increasing number of people with compromised immune systems have enhanced the opportunities for emergence and spread of resistance. Locally, breakdown of public health systems due to war, poverty and famine create hot spots for spread of infections. Increased migration, travel and trade globalise the problem by facilitating spread over long distances.

Emergence of antimicrobial resistance in well-known pathogens makes new killers out of old ones. The infections defy standard treatment, and alternatives are not always available. In the near future, we cannot expect new antimicrobials to be the solution. Can we, and are we prepared to, handle these diseases without antimicrobials?

Antimicrobial resistance is problem common to developed and developing countries, affecting current and future generations. The problem increases gradually and insidiously rather than in a catastrophic way. Because the worst consequences are yet not seen, there is a risk that we do nothing. On the other hand, there may still be a time-slot to take action. The WHO, among others, has issued recommendations on the containment of antibiotic resistance in different sectors (WHO, 2001). Existing knowledge must be translated into concrete activities. The global spread of resistance through trade and travel implies that unless tackled in all parts of the world, resistance will not be sufficiently contained.

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The complexities and challenges of studying zoonotic agents in wildlife

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We have entered a period in history where the rate of discovery of novel infectious agents is unprecedented. Nearly 75% of all infectious diseases classed as emerging are zoonotic, and many of these have spilled over from natural wildlife reservoirs into humans either directly or via domestic or peri-domestic animals. Diseases such as Severe Acute Respiratory Syndrome (SARS), Avian Influenza, Nipah virus, West Nile virus, and HIV/AIDS are examples of zoonoses that have had significant impact on human health. The emergence of many zoonotic diseases can be linked to anthropogenic factors such as global travel, trade, agricultural expansion, deforestation/habitat fragmentation, and urbanization - where the interface between humans, domestic animals, and wildlife is increased, creating more opportunities for spillover events to occur. The epidemiologic study of wildlife requires a broad-spectrum approach that includes understanding the ecology of the target species so that appropriate study designs can be implemented. Wildlife studies involve uncontrolled populations, and many of the complexities that arise from surveying wildlife are related to the inherent difficulties of capturing, re-capturing, sampling, and running diagnostic tests on species that often have never been studied. Working in remote locations also makes the collection, storage, and transport of biological samples difficult, especially when optimal diagnostic results depend on maintaining a cold chain. Identifying appropriate diagnostic tests and facilities that have the technology to test samples represents another challenge, especially when working in developing countries or with agents that require the highest level of biosecurity, such as Nipah virus. Finally, ethical considerations must come into play when working with animals, and the conservation status of the target species should influence the type of sampling techniques (destructive vs non-destructive) that are used. This discussion will use Nipah virus and SARS investigations as examples of the challenges and complexities that occur when surveying wild animals for zoonotic agents.

Preparedness of the EU against new emerging diseases - Animal and public health perspectives

Jaana Husu-Kallio, Deputy Director General, Health and Consumer Protection DG, European Commission

Introduction

Ladies and Gentlemen, emerging disease problems pose a special challenge to decision makers, including the European Commission.

In my presentation I will give an overview of the Community approach to these problems, and in particular of the actions being taken by the Commission in this regard, to better protect both animal and public health.

Animal health aspects

Animal health has major social, economic and political impact and implications. Certain infectious animal diseases may run an epizootic course, with high morbidity and mortality, whilst others may be transmitted to humans (zoonoses). In accordance with the "stable-to-table" approach, animal health is a very important element for food safety, which has been underlined in the Commission's "White Paper on Food Safety", as most food is based on or includes products of animal origin. Furthermore, it is more and more evident that many infectious agents emerged in humans are of animal origin, including for example HIV/AIDS.

In principle, any movement, trade or placing on the market of animals, of their products and of food of animal origin entail a risk for public and/or animal health. Appropriate measures are therefore necessary to reduce this risk to an acceptable level (a "zero-risk" approach is not a realistic option) and to ensure food safety. However, these measures may constitute major trade barriers leading to very costly trade disruption and international disputes. In the last years, increased international trade has made these problems more evident than in the past.

The EU animal health policy has been progressively developed and supported by harmonised legislation since the early 1960s, with the main aim of reaching an maintaining a high status of animal health throughout the EU, which is fundamental to ensure the welfare of animals, food safety, sustainable development of agriculture, the functioning of the single market and the possibility to export to third countries.

Indeed, the bulk of this legislation was adopted in the early 1990s within the framework of the Common Agricultural Policy and of the fundamental objectives of establishing a single market, comprising movement and trade of animals kept for food production, their products and food of animal origin, which can only take place if adequate health standards are guaranteed. In the last years, an effort has been made to ensure full consistency of the animal health policy with the developments of the EU policies on food safety and public health.

The implementation of the measures provided for in the legislation rests with the Member States. The European Commission is responsible for proposing primary legislation to the Council and the European Parliament, and for adopting appropriate implementation rules and for ensuring that EU legislation is properly applied. Financial provisions and resources are also available to support Member States and Commission actions in this area.

Detailed and extensive Community legislation on prevention, detection and control of animal diseases and to ensure food safety has been developed and is in place, including on contingency plans established in each Member State, so that the competent authorities can ensure the rapid implementation of the most appropriate measures, taking the local epidemiological situation into account and the specific health risks identified.

EU and national reference laboratories are also in place in relation to the said diseases to ensure uniformity of testing and expert support to the Commission and the Member States.

In case of an emergency related to an animal disease or a food safety problem, the Commission may also adopt ad hoc additional control measures (safeguard clauses), if they are necessary for a better protection of public and/or animal health. Therefore, the Commission plays a key role in the management of the most urgent and important animal health and food safety problems in the EU.

Before adoption, these rules are discussed with the MSs experts in the Standing Committee on the Food Chain and Animal Health, where information on the animal health situation is regularly exchanged.

In the adoption of its rules and when taking its decisions, the Community must also make proper use of scientific advice. For this purpose the European Food Safety Authority has been created and is actually working at providing scientific support and opinions, also in the area of emerging diseases.

In this legal and institutional context, the Commission has tackled several animal health and food safety crises occurred in the EU in recent years, such as those occurred in relation to BSE, dioxin, Foot and Mouth disease and Avian Influenza. The lessons learned on these occasions would be certainly very useful in case of the appearance of an emerging animal disease or a threat related to food.

In some specific cases like Avian Influenza, which is indeed an emerging animal disease with major public health implications, the EU has also taken a very proactive approach, including a survey on domestic poultry and wild birds aimed at an early detection of the so-called low pathogenic strains of Avian flu, that may mutate into Highly Pathogenic strains and then cause major animal and public health problems.

The European Commission is currently working at an updating of current legislation on this disease, that in the future should include regular and compulsory surveillance programmes and disease control measures for Low Pathogenic Avian Influenza, to prevent the occurrence of the much more dangerous Highly Pathogenic Avian Influenza.

However, I am very well aware that the fact that in the Community there are effective systems in place to tackle emerging animal diseases problems and that further legislative work is being carried out in this area does not mean that these problems can be easily solved. Sometimes they can only be contained, and I will give you an example in this regard.

In the last years, the southern Member States of the Community are suffering due to a disease of ruminants, Bluetongue, fulfilling all the characteristics of an emerging disease. This viral disease is transmitted by insect vectors. Most likely, changing climatic conditions in Africa, in the middle-East and in Europe are making possible its continuous northbound spread.

Experience gained in many countries in the world, including in highly developed countries such as Australia and the USA, shows that wherever appropriate environmental conditions prevail, effective control of Bluetongue is difficult and its eradication practically impossible, at least at present.

On the occasion of the recent incursions of Bluteongue in southern Europe, the Member States concerned and the European Commission have reacted to the emerging threat, making use of all possible tools. Nevertheless, it is becoming evident that this disease cannot always be effectively controlled with current tools and there is a need - for example - of better vaccines against it.

Therefore, while from one side disease agents continuously find new ways to emerge in the current rapidly changing word, we expect that science and new technologies find appropriate solutions to the newly emerged problems. And this is also valid for emerging disease of humans.

Public health aspects

I wish now to move to the pubic health aspects of emerging diseases.

HIV/AIDS, variant Creutzfeld-Jakob disease and SARS are only few examples of highly fatal human diseases recently described. More then 40 new pathogens affecting humans have indeed been identified during the last decades.

Human suffering and economic burden due to conditions caused by emerging micro-organisms are very high; moreover, large parts of these agents have a potential for international spread.

Although it is not always possible to know if these diseases are new in humans, or whether they have been present but unrecognized throughout the years, many emerging diseases are thought to be due to a closer contact of man with their reservoirs in nature, with a successful «jump» of the infectious agent from animal to man across the species barrier.

Avian influenza is the more recent and typical example and also the SARS virus is being suspected to have originated through this mechanism.

Also the reappearance or increase of infections which had formerly fallen to levels so low that they were no longer considered a public health problem could represent an emerging, or re-emerging, issue. Tuberculosis is increasing worldwide due in part to its close association with HIV infection; cholera has been re-introduced into countries and continents where it had previously disappeared, and where it can spread because water and sanitation systems have deteriorated; arthropod borne infections like malaria and dengue have started to occur in areas where mosquito control has broken down.

Micro-organisms resistant to antibiotic drugs emerged and spread soon after the introduction of these drugs and in parallel with their use. If the arsenal of drugs against infectious diseases loses its power, the future for patients with even a banal ear infection will become bleak.

The SARS epidemic and the evolution of the avian influenza epidemic in Asia in recent months underlines the importance of effective coordinated actions.

We are now entering in the epidemic season of human influenza and the possibility that a new pandemic virus could emerge should not be underestimated.

At present, no indication that human-to-human transmission is taking hold in Asia, nevertheless, scientists deem that an influenza pandemic is highly likely to occur, and is a matter of when, not if.

Since last decade alarm over emerging diseases has resulted in a number of national and international initiatives to restore and improve surveillance and control of communicable diseases.

Surveillance of communicable diseases is of pivotal importance in order to promptly detect and respond with appropriate measures to emerging threats.

Transparency and sharing information nationally and internationally is a key factor in infection control and in assuring a timely and effective response.

For this reason the Commission has been working closely with Member States to put a series of instruments and policies in place, taking into account the very different legal framework in which Community actions take place when human health is at stake, compared to animal health or food safety.

However, it must be well taken into account that in accordance with the EU Treaties, the legal framework in which Community actions take place in the public health area is very different from the one existing in the animal health area.

The Commission role is much more of coordination of Member states of efforts than of real leadership of Community actions, as it is the case for animal health.

Within this context, since the late 1990s EU countries have been steadily building their cooperation in the area of disease surveillance.

A range of Communicable Disease Networks was established in 1999, linking public health institutes around the EU and beyond. These Networks, staffed by our national partners and co-financed through the EU′s public health program, are capable of providing rapid alerts on new disease outbreaks, as well as coordinating routine disease surveillance.

In responding to Bioterrorism and SARS we have gained valuable experience.

An Early Warning and Response System and the Health Security Committee and Action Plan have been developed.

These systems have worked well, given their current capacity. Of course the system is only as good as the quality and timeliness of the information provided to it.

In particular the Community's Early Warning and Response System is a very useful tool to permit and to strengthen the capacity of circulating important information among the Health Authority competent for taking measures in Member States; this allows not only the strategic flow of information, but also consultation between experts. This kind of timely expert information exchange is essential to ensure a coherent and effective response during emerging events.

To cope with the emerging risk of a pandemic influenza the Commission adopted a working paper on ”influenza pandemic preparedness and response planning in the Community”. The Plan will address key issues of co-ordination. We intend this to be a consultative document to promote effective policies and measures within the EU.

Planning and coordination will be key weapons in tackling any future emerging threats.

In December 2003, the European Council, the summit of European leaders, chose Stockholm as the seat of the European Centre for Disease Prevention and Control. The European Centre for Disease Prevention and Control we are creating today will network Europe's health knowledge. It will enable:

More effective continent wide surveillance of infectious diseases;

Better preparation for – and response to – future epidemics;

Better disease prevention and control cooperation in Europe and with its international partners.

Cooperation with neighbours, and with international partners, is not just about friendship and solidarity. It is about being effective in the fight against disease.

However, Europe-wide disease surveillance now needs to be put on a proper footing. It needs the stability of multi-annual core funding from the EU budget. It needs a dedicated team of central staff to support and develop the network. It needs to provide a focal point for expertise and training of professionals in the field. The European Centre for Disease Prevention and Control will bring all this into being.

When such health threats arise the EU Institutions and Member States need expert scientific advice, and they need it quickly.

This is where the Centre will have a crucial role to play. Using its network, the Centre could, on request, rapidly pull together outbreak investigation teams made up of Europe's top disease investigators.

There they could work with the relevant national authorities, and with the WHO, to identify the cause of the disease, and give advice on surveillance tasks and counter-measures such as isolation of patients and tracing of contacts.

The Centre will coordinate work in Europe's leading laboratories to analyse samples collected during outbreaks, and bring together key experts to assess the properties of the threat posed by disease outbreaks. The Centre would thus be in a position to judge the risks posed and advise on the options available to contain the disease.

Within a short time of an outbreak occurring, the Centre could help the authorities – and the public – across Europe know the sort of threat they are facing and the scientific basis for the various measures available to respond to it.

Conclusions

Emerging diseases poses a serious threat for citizens and a particular challenge for scientists and decision makers.

How to ensure that effective measures are taken to prevent and control them at Member State, Community, international level?

How to ensure that the measures being taken are proportionate to the risks and based on a proper evaluation of costs, benefits and risks, given that the risk posed by emerging disease and the benefits from disease prevention and control measures are very often unpredictable?

How to ensure that the limited resources available are spent in the most suitable manner and address the most serious problems?

These are questions to which nobody has easy replies, neither at the level of individual Member States or at Community level. For these reasons, scientists and decision makers must work closely together. For these reasons the Member States, the European Institutions and the European agencies such as EFSA and the ECDC must work closely together.

The European Commission is working at the development and reinforcement of this synergistic approach.

How we are prepared against new emerging diseases in Sweden – Animal health perspectives

Bengt Larsson, Head of Division of Strategic issues, Swedish Board of Agriculture, Jönköping, Sweden

New emerging diseases will occur in the future, some of them will affect animal species only, others both animals and humans (zoonoses). So what can do about them?

From a legal point of view we are rather well prepared. Swedish Board of Agriculture (SBA) is the competent authority for animal diseases and can respond to new emerging diseases. Both the Act of epizootic diseases, the Act of zoonotic diseases the Act of sampling are powerful acts which give SBA the mandate to put relevant restrictions on affected herds, cull animals and to clean and disinfect premises. SBA can in an amendment of a regulation insert new diseases on the list governed by Act of epizootic diseases as well as for Act of zoonotic diseases. We have contingency plans for most of OIE A-listed diseases, including avian influenza, which tell us what to do in the event of an outbreak. These contingency plans may partly apply for new emerging diseases, and most certainly when it comes to the organisation to combat diseases. The contingency plans also contain rules and recommendations for cooperation with other authorities (e.g. National Veterinary Institute, National Food Administration and County Administration) involved in combating animal diseases.

In the event of a severe animal disease, certainly for diseases belonging to OIE A-list, the EU Commission will closely follow the situation and take necessary action. Therefore it is possible that the Commission will take action following a vote in the Standing Committee of Food Chain and Animal Health. However, the Commission and Community reference labs will support us with help if we ask for it.

New emerging disease is a challenge and most often important epidemiological and microbiological as well as other data are lacking. It is a challenge for the scientific world to work fast and coordinated in order to provide relevant information in a short time necessary for an accurate control and possible eradication of the disease. In absence of important information, the control and eradication will be difficult if at all possible.

A new emerging disease will probably start somewhere outside Sweden. Most likely a lot of information directly from the affected country or via international organisations and/or via EU will flow into Sweden. When it comes to emerging zoonoses the information will go to both the competent authority on the human side and the animal side. Today there is no decided procedure for how the information shall flow between the human and animal side. Moreover, there is no established procedure for a common risk assessment, management and communication.

In order to be better prepared for new emerging zoonoses, routines for information flow, a procedure to secure a proper risk assessment, management and communication common to both human and animal side, and a contingency plan should be established. Such a contigency plan should at least include contact details and procedures for securing a harmonised control and possible eradication of the disease.

How we are prepared against new emerging diseases in Sweden – Public health perspectives

Anders Tegnell, Senior Consultant, National Board of Health and Welfare, Stockholm, Sweden

The Swedish system for Infectious Disease Control is based on three major counterparts.

SMI (the Swedish Institute for Infectious Disease) control who is the expert authority and collects and analysis surveillance data.

SoS (the National Board of Health Welfare) who is national supervising and coordinating authority in the area of infectious disease control.

The County medical officers who are responsible for the operational infectious disease control at county level. From legal point of view we are rather well prepared.

The control of human infectious diseases is mainly regulated by the Infectious Disease Act (2004:168). It gives the authorities the mandate to do a medical examination of suspect cases, treat them and to do contact tracing. They can also inform/advice/instruct patients and isolate infected patients. For certain diseases quarantine and border control are also possible.

One of the essential parts of the preparedness for new diseases is the early recognition of an ongoing outbreak. Experiences tells us that there are an increasing amount international outbreaks identified every year with a mixture of new and old diseases. Most of the new disease are first recognised by health care workers who react to clusters of patients with new and unusual symptoms. The Swedish surveillance system for infectious diseases is very well developed. This system has been strengthened by a number of EU wide networks which makes the pooling of data and thereby recognition of trends possible at an earlier stage. Like all systems like these it can only identify outbreaks among known diseases and usually quite late in the outbreak. Media has proven to provide an early indicator of outbreaks of unknown disease which is used to an increasing degree. Furthermore a number of Early Warning systems makes the communication about potential new diseases among national authorities easier and more adequate.

Once a potentially new disease or outbreak is identified there is a need for system for analysing and reacting to the incoming data. The main actor as described above are then SMI, SoS and the medical officers where SoS has the role of coordinator when the outbreak is big or has international aspects. Sweden has developed additional resources at national level, these includes an advanced laboratory facility with the potential to diagnose any disease. There are also resources for the treatment and transport of highly contagious patients. Finally there is a group of filed epidemiologist who are ready to assist in the management of a national or international outbreak.

Evidently the management of any bigger outbreak or complicated new disease requires an intense collaboration between different national and regional authorities. In the area of zoonotic diseases this is facilitated by the Zoonotic Board. Recently a network among the operationally responsible authorities at national level has been created. This network will make the communication about zoonotic outbreaks and coordination of countermeasures more efficient.

The BSE crisis – A Lesson in Economics

Patrick Cunningham, Professor, Trinity College, Dublin, Ireland

Introduction

BSE was undoubtedly a watershed – the biggest single peacetime crisis to hit European farming in a century. Part of what made it unique is not just that it is a new disease, but a new class of disease. We now know what the causative agent is – a prion – a hundred times smaller than a virus, and millions of times smaller than bacteria. When the first case in the epidemic was recorded in a dairy cow in the South of England in 1986, such infectious agents had never been heard of. The most important thing that has been learned since then is that the disease was spread by meat and bone meal in livestock feeds. We still do not know exactly how it started, how to cure it, or what to expect in the future from the dreadful human version of the disease, vCJD. However, despite these uncertainties, the various containment measures put in place seem to be gradually bringing the epidemic to an end.

The epidemic has brought about a sea change in attitudes among consumers, in the scope and nature of government controls, and in the economic and technical life of livestock producers. Responding to the crisis, the European Association for Animal Production in 2003 published a report* on BSE and its consequences. In preparing material for that report, I made some calculations on the cost of the epidemic, and this presentation is largely based on these.

The course of the epidemic in UK

BSE was first confirmed in a cow on a dairy farm in the south of England in 1986. It is believed that unrecorded cases had occurred earlier than this. The disease, occurring in both sexes in adult animals, is a neurological condition involving pronounced changes in mental state, abnormalities of posture, movement and sensation. Symptoms characteristically last for several weeks and are progressive and fatal. Post-mortem examination of bovine brain demonstrated similar pathology to the family of Transmissible Spongiform Encephalopathies (TSEs), a group of diseases occurring in several mammalian species and in humans. The new disease became known as Bovine Spongiform Encephalopathy (BSE), a form of TSE thought at the time to be specific to cattle.

In the years following 1986, the number of cases in the UK increased dramatically, peaking at 37,289 cases in 1992. Since then, the epidemic has declined steadily, and the number of cases reported in the UK in 2003 was 612. While the disease has spread to other countries, over 95% of all recorded cases to date have occurred in the UK.

In 1988 the disease was declared a zoonosis, an infectious disease transmissible under natural conditions from vertebrate animals to man. This was noteworthy as conventional wisdom until then held that the disease was species-specific and posed no danger to human health. The confirmation, in 1997, that BSE was no longer confined solely to cattle, but was the probable cause of new variant Creutzfeldt-Jakob Disease (vCJD) in humans was a most significant event . The first case of human vCJD was detected in the UK in 1994, and by 2004 over 140 cases had been recorded. This threat to human health has led to the implementation of a number of critical response measures.

The origins, progress and eventual control of BSE in the UK were marked by a number of crucial advances in knowledge and consequential responses.. The only common feature of all investigated cases was the use of commercially produced compound feed containing meat and bone meal (MBM). Following the understanding that MBM was the probable medium for spread of the disease, progressive measures were established to eliminate infectious material from MBM and to remove MBM from animal feed. In July 1988 ruminant MBM was banned specifically from ruminant feed and later (1996) from all animal rations. Meanwhile specified risk material (SRM), including ruminant offal and brain, was excluded from human consumption and animal feed and was banned from export from the UK. By 1995 regulations on mechanically recovered meat (MRM) were also introduced.

These measures, increasingly effective in the UK, resulted in the displacement of MBM from the UK market. This led to an increase in export of MBM, initially to EU countries, and as its use was banned there, to more distant markets. In August 1996 all MBM in the UK was recalled for storage and destruction.

As research and field experience produced new information on the nature of the disease, containment and eradication measures were steadily increased. These have been largely successful in preventing new infections in the cattle population. This is confirmed by the fact that, with few exceptions, all newly recorded cases are in animals born before 1996.

The success of the measures taken to prevent infected animals entering the human food chain is not yet clear. Numbers of vCJD cases have shown a rising trend since 1994. A number of uncertainties (exposure/dose, susceptibility, incubation period) mean that accurate prediction of future numbers is difficult. Most estimates put the total number of expected cases between a few hundred and several thousand.

International Spread

Some years after the BSE epidemic was established in the UK, cases began to occur in other countries. Beginning with Ireland (1989) the disease has now been reported in over 20 additional countries, most of them in Europe . In most countries the numbers of cases are very small. The latest incidence figures(OIE, 2004) show that 18 countries reported BSE cases in 2003. Incidence(number of cases per million bovines) was highest in those countries which were the first to experience the disease(UK 122, Portugal 137, Ireland 58, Spain 46, Switzerland 25). France, Germany, Italy , Netherlands and Belgium each had about 10 cases per million bovines. It should be noted that the reported incidence rates in EU countries increased sharply from 2001, following the introduction of "active surveillance" measures, which included testing of all fallen animals and of all animals above a certain age(24 or 30 months) at slaughter.

Slovakia, Slovenia, Poland and the Czech Republic all had less than 10 cases per million. Outside of Europe, Japan had 15 cases, and Canada and USA each reported single cases in May and December 2003 respectively. The disease has not been reported from Sweden.

Because of the long incubation period for BSE, it has in many cases not been possible to identify the source of infection in a country. In some cases, for example the U.S., an infected animal was imported. However, the general conclusion is that the primary medium for spread of the disease to so many countries has been trade in contaminated feed.

Cost of the Epidemic

For most animal disease outbreaks, the costs of containment, eradication and economic adjustment are temporary. After the outbreak has been brought under control, the industry returns to normal. The Foot and Mouth disease outbreak in the UK in 2001, for example, which cost an estimated 13 billion Euro and involved the slaughter of 6 million animals, was brought to an end in eight months. BSE has been different. New and permanent changes have been introduced which impose substantial additional costs for the indefinite future.

The cost of the BSE epidemic has varied from country to country with the incidence of cases and with the different policies applied. The UK had by far the largest number of cases, but adopted a policy of slaughtering only affected animals, on the grounds that lateral transmission was not believed to occur. Other countries, with fewer cases, slaughtered the whole herd where an affected animal was found. This was regarded as a reasonable precautionary measure given a degree of uncertainty about

However, the largest cost is not involved in control measures, but in the permanent loss in value of each beef animal produced due to the exclusion from the food chain of certain carcass components. In addition, new costs per animal are incurred for the safe disposal of waste material, for animal testing, and for extra procedures and precautions in the slaughtering industry. From analyses presented in the EAAP report it is clear that a figure varying around €100 per animal is involved. Over half of this is the loss in carcass value, and the remainder consists of Meat and Bone Meal (MBM) disposal, depopulation of affected herds, and BSE testing costs. The average value of all bovines slaughtered in the EU is close to €1000. Thus, about 10% of the value of each beef animal produced has been lost.

Irrespective of the future course of the epidemic, most of this loss in value per animal will continue. Some MBM use might be resumed, and BSE testing costs might be reduced. However, the changes in meat industry practices will be permanent. Furthermore, the calculations given here take no account of the costs associated with vCJD in humans, nor of the impact of BSE on beef prices at retail level(UK beef producers now receive half the price, in real terms, that they received in the 1980s). The figure of 10% of the value of beef output is therefore a reasonable starting point from which to estimate the economic impact of BSE.

In 2000, beef accounted for 10.2% of the total value of agricultural output in the EU, or €27.5 bn. The annual loss as a result of BSE can therefore be estimated approximately as 10% of this, or €2.75 bn. Discounting all future losses this gives a Net Present Value (NPV) of approximately A/r, where A is the annual loss and r is the discount rate. With an annual loss of $A = €2.75$ bn and a discount rate of $r = 0.03$, this gives a NPV of €92 bn.

This is an enormous sum, approximately equal to the whole annual budget of the EU. Higher discount rates or a shorter time horizon would produce lower estimates. However, no reasonable recalculation is likely to reduce this estimate by 50%. Even if, as is expected, the BSE epidemic in Europe is coming to an end, its economic shock effect on the livestock sector has been immense.

Initial calculations of the cost of BSE in the U.S. have focussed on the risk to export markets(10% of output and worth $2.6 billion in 2002), particularly to Japan and Korea, and on the potential drop in domestic beef consumption. The cost of adjusting to these market disruptions will undoubtedly be severe. Canada faced similar trade disruption after the announcement of a single BSE case in May 2003. They estimated the cost on the export front at $11 million per day. In both countries, the impact of the permanent changes in production and processing is still developing. Many of the changes implemented in Europe are likely to be put in place, beginning with a requirement for all bovines to be individually identified.

Meat and Bone Meal

During slaughter and processing 33 - 43% of live animal weight is removed and discarded as inedible waste. This material, which includes fat trim, meat, viscera, bone, blood and feathers is collected and processed by the rendering industry to produce high quality fats (tallow) and proteins (meat meals) that have traditionally been used in the animal feed and oleochemical industries around the world.

Renderers in the EU process about 16 million tonnes, while those in North America process nearly 25 million tonnes of animal by-products each year. Argentina, Australia, Brazil and New Zealand collectively process another 10 million tonnes of animal by-products per year. Total value of finished rendered products worldwide is estimated to be between US $6 and $8 billion per year .

Unprocessed animal by-products contain 60% or more water. When processing these raw materials heat is used to remove the moisture and facilitate fat separation. Globally, the rendering process reduces the total volume of animal by-product from 60 million tonnes of raw material to about 8 million tonnes of animal proteins and 8.2 million tonnes of rendered fats Stored properly, these finished products are stable for long periods of time. Heat processing also sterilizes the product. The temperatures used (133°C - 145°C) are more than sufficient to kill bacteria, viruses and many other microorganisms. Unfortunately, it appears that rendering does not destroy the mutant prion thought to be responsible for BSE.

As a feed, MBM is an excellent source of supplementary protein, has a well-balanced amino acid profile and is high in lysine (usually the first limiting amino acid). In addition, MBM is an excellent source of calcium and phosphorous and some other minerals (K, Mg, Na etc.). Until the BSE crisis, it had been considered a safe feed source, and had for over 40 years been included in pig, poultry and dairy rations on the basis of its cost and nutrient value.

In Europe, the MBM ban has resulted in a need for alternative protein sources in feed. For all the protein from MBM to be replaced in the EU, about 2.3 million tonnes (MT) of soya bean meal would be needed (additional free amino acids not considered). However, in the context of the EU annual requirement of 56 MT of high protein animal feed, of which 36 MT is imported, in terms of ensuring amino acid supply, the ban is a minor problem. The differences in cost are also considered insignificant.

The other part of the problem is the disposal of MBM if not used in feeds. The alternatives are incineration, co-incineration (cement industry, waste incineration or fertiliser processing), burial, landfill, biogas or composting. Most European countries are resorting to some form of incineration. However, this still implies initial rendering of the material and storage before incineration. There are problems of capacity (the incineration capacity in the EU is 2.5 million tonnes while the quantity to be incinerated is put at 3.6 million tonnes), as well as of addition to greenhouse gas production.

It has already been noted that high temperatures are essential for the sterilization of the material. Composting or other biological methods do not achieve the necessary heat to make the material microbiologically safe. Burial, landfill and even storage of dry material pose unacceptable environmental risks as they are subject to incursion of vermin, birds and other animals.

In any case, the costs of disposal are very high. The total costs of the alternative use of 3.6 million tonnes of MBM varies from €1.0 - 1.8 billion. On average, every kg of MBM not used as a feedstuff incurs costs of about €0.32. This is nearly twice the 1999 supply price of MBM.

The Changing Context: an Industry in Transition

The BSE crisis occurred, first in the UK, and then throughout Europe, against a background of rapidly changing structures in the production, marketing and consumption of food. While these changes apply across the food and agriculture sector, they have been particularly marked in meat, and especially beef.

Some of these changes flow from the progressive liberalisation of trade within the European Union. A wider trade liberalisation under the World Trade Organisation (WTO) is also a factor. However, most change is a result of competitive pressures and technical and economical evolution in production, processing and distribution. Finally, changes in the nature of consumer demand have also had an impact.. For many involved in production, processing or distribution, the constant adaptation to change made this an industry already in crisis, and ill placed to absorb the impact of a sudden new crisis such as BSE. Furthermore, the rapid change which has been taking place in the industry interacted with the BSE crisis, and in some ways contributed to it. Finally, the changes which can be observed in the industry will continue. In looking to the future, therefore, it is essential to understand the causes, nature, and probable consequences of structural change

The BSE crisis was thus an unwelcome addition to a set of interrelated challenges already facing the European livestock production sector. These include:

Long term decline in real producer prices of about 3% per year.

Changes in EU policy which will expose producers to increased competition from other areas of the world.

A growing dependence for economic survival on politically sensitive subsidy programmes, paralleled by a declining influence of producers on policy formation.

A major power shift in the food chain to dominant retailing and processing firms, further accentuating price pressure on producers.

Increased costs for enhanced controls and compliance.

Rapid changes in the pattern of consumer demand.

Consumer distrust, fed by recurrent food scares, and amplified by a sensitised media.

As the numbers of producers decline, and as the food chain lengthens and becomes more anonymous, the mutual knowledge and understanding between primary producers and ultimate consumers is reduced.

A historical structure where three quarters of the 7 million farms in the EU do not have sufficient scale to provide one full-time work and income opportunity.

The prospect of integrating the 10 million additional farmers in the 10 countries acceding to the EU.

An intensity of land use in some areas that causes progressive nutrient overloading of the environment

Discussion

The BSE crisis has signalled the need for a fundamental reappraisal of the animal production industry's priorities and practices..This is against a background of continuous adaptation and change whose principal benefit to society is lower food prices. The costs are more diverse, and include reduced incomes for farmers, and longer, and therefore less transparent, food supply chains. The balance of gains and losses, and of who the beneficiaries and losers are, has been insufficiently quantified and debated.

While the balancing of these interests is a matter for deliberation in the whole of society, policy is eventually crystallised into regulation through the political process. Given that progressively more unrestricted competition is the future, how can valued objectives such as ethical standards in production, authenticity or quality of product, or fair terms of trade be achieved? Since, under the free market, profit maximisation drives all decisions, it seems that these other objectives are unlikely to be served unless the regulatory framework makes them a requirement. Already, substantial change in this direction has taken place to guarantee food safety. A major task for the future is to debate and refine the regulatory context under which the livestock sector can serve the broad goals of society.

The BSE epidemic, which began in 1986, is now, with high probability, drawing to a close. Though 95% of cases occurred in one country, the economic impact has been felt by all beef producers in Europe,Japan and North America. Up to 10% of the annual value of beef output has been lost (half through reduced animal value, half in additional costs for control measures). Though the epidemic will in all probability end, much of the cost and loss will continue indefinitely

The experience of the epidemic has highlighted deficiencies in the production and processing industries, and in the public food safety structures. The dangers in recycling industry waste as feed materials were not appreciated; excessive and opportunistic trading and movement of materials, animals and products was part of the system; identification and traceability were deficient. The response of the public authorities suffered from divided responsibilities, untransparent procedures, insufficient knowledge, and a culture of caution.

Several negative consequences have arisen from these deficiencies. Of prime import has been permanent damage to consumer confidence not just in beef, but in all foods. The reputation of the scientific establishment for providing objective and independent information has been severely downgraded in the public mind. Government authorities have been perceived as protecting sectoral interests rather than the public in general.

Positive outcomes include the wave of corrective measures at national and international levels, and the establishment of new structures and authorities to bring greater supervision, accountability and integrity to the food chain. These positive developments, while they impose extra costs in the system, costs which will largely fall on primary producers, should be welcomed as necessary and overdue.

In the face of these formidable challenges, and energised by the BSE epidemic, European livestock producers, processors and the relevant public authorities have made substantial changes. New food safety agencies have been set up. All cattle and most sheep are identified. Traceability rules are being implemented. New controls on the feed industry have been introduced. Policy at national and EU levels has been adapted. Similar changes are following in Japan, Canada and the USA.

Many commentators, representing views among producers as well as consumers, feel that these adjustments are not enough. These recommendations for more radical restructuring are aimed at returning to shorter, more local food chains, rewarding good practice and product quality, and responding to consumer expectations, particularly on safety. The dilemma for producers, policy makers and society is that market forces alone will not deliver these objectives. In particular, it serves the economic purposes of large processing and retailing firms to focus consumer trust on company brands rather than on products identified by region or production system. Companies also need to minimise the costs of these supplies, a goal often best served if their suppliers are producing an undifferentiated product.

The non-monetary values involved in livestock production (safety, ethical production, environmental protection, fair trade, conservation of rural society, respect for tradition, and others) are important. However, it is quite ineffective to simply advocate respect for these values. They will be respected only if it is profitable to do so, or there are penalties involved in not doing so If the non-monetary values are to be respected, the free market needs to be circumscribed by formal requirements. The task for the future is to develop these so that they achieve their objective, without simply serving the interests of particular groups or increasing the burden of regulation to unreasonable levels.

The failures which led to the BSE crisis have provided a hard lesson for all involved in the livestock sector, particularly in Europe. A technical innovation (use of MBM), which had been judged safe, and had been widely used for more than 40 years, proved to be the instrument which spread a new and frightening disease in animals and humans. All scientific innovation is now suspect. This has strengthened public opposition to developments such as GM crops, use of BST in milk production, or growth promoters in meat production. Producers are often ambivalent – appreciating the technical advantages, but unsure on long term safety and public reaction.

Policy is driven mainly by these wider public attitudes. Present EU policies do not allow these technologies to be used. As evidence on food safety and other concerns accumulates, and as public attitudes change, these policies may also evolve. Livestock producers must work within these regulations. They must also recognise that Europe has chosen a deliberately cautious path, and that though they are precluded from taking advantage of some technical developments, this can be offset by increased consumer appreciation of and loyalty to local products.

Conclusions

• The BSE epidemic, which began in 1986, is now gradually coming to an end. Though knowledge is incomplete, enough is known about the disease to be reasonably confident that such an epidemic will not recur.

• Three principal questions remain unresolved: the origin of the BSE epidemic; the future of vCJD; and what to do with the 16 million tonnes of animal byproducts produced annually by the slaughter industry.

• Loss of value and cost of disposal of MBM exceed 1.5 billion Euro per year. Though new EU legislation could permit over 80% of this material to be used again in livestock feeds, the best option is to continue the ban on its use.

• The cost of the epidemic has been enormous, and is estimated here at about 10% of the annual output value of the European beef sector. The discounted present value of these costs is estimated at €92 billion.

• The progress of the epidemic was marked by many deficiencies and failures, of which two are particularly noted.

- The inadequacies of public information, particularly in the UK

- Failure to prevent international spread through contaminated meat and bone meal.

• Ongoing changes in the industry are documented: changing consumer requirements; concentration of processing and retailing power; declining producer prices, and reduction in numbers of full time producers. These changes represent both the causes and effects of a continuing shift in the terms of trade to the disadvantage of producers. To ensure fair trading, increased controls to prevent abuse of economic power may be necessary.

• The ten countries which are destined to join the EU have 40% more farmers than in the EU 15. The challenge of accommodating them in a common EU policy, market and budget has major implications for the existing EU livestock sector.

• European production costs for milk, red meats and cereals (the raw material for white meat production) are higher than in the traditional exporting countries for these commodities. This is partly due to relative scales of production units. With progressive trade liberalisation, continued pressure on producer prices is inevitable.

• Steady increases in unit scale and intensification, particularly in pig, poultry and dairy enterprises, have generated problems of nutrient overload in some regions. The industry will need to acknowledge and address these problems.

• In the present context it is ironic to note that the situation on animal disease in Europe has never been better. All major diseases are eradicated or under control. For the future the emphasis will be on the control of enzootic diseases, largely through husbandry practices; reduction, and eventual elimination of routine use of antibiotics in feeds; and intensive research to cope with emerging diseases.

• Scientists have lost credibility as a result of the BSE crisis. While it is more critical than ever that public policy be informed by the best scientific advice, those involved in providing such advice must more carefully identify and distinguish the factual basis from the value judgements involved.

• Scientific innovation has also lost favour with the public, particularly where it affects food and health. The livestock sector will need to weigh carefully the technical benefits against the risks and public acceptability of technologies such as GMOs, BST in milk production, growth promoters in meat production.

• Given that over 95% of European livestock production is destined for European consumers, the production industry must concentrate on securing their loyalty by fulfilling their expectations on

- food safety;
- transparency and accountability;
- quality and variety, including response to the demand for regional and organic products.

• New ways need to be found to build the community of interest of producers, processors, and retailers in meeting these goals.

* After BSE – a Future for thr European Livestock Sector. EAAP Publication No 108, 2003. Wageningen Academic Publishers and www.eaap.org/ after bse

Emerging infections in perspective and how do we best use our experiences

Lars O. Kallings, professor, MD PhD, Assistant Secretary-General and Special Envoy, United Nations

I am very impressed by these first rate presentations and do not think that I can contribute by direct comments. Rather I would consider the issues from another angel, namely that of the microorganisms by looking at their survival strategies. What makes a microorganism successful, a winner which will spread its genetic material over the globe, - a ranking of successful characteristics.

Peaceful co-existence is the most advantageous strategy, particularly when the microorganism is an obligatory symbiont needed by the host organism. Peaceful colonisation of man, animal or natural habitant guarantees survival. In contrast being a pathogen, a predator, may be a hazardous strategy, especially for such pathogens which do not have a reservoir in other animals or in nature.

For instance the smallpox virus outsmarted itself and became extinct. It was too dangerous to human beings and had no other host than human beings. Similarly, polio virus will probably disappear from earth. Potentially, morbilli virus may also meet the same destiny.

Then, there are some pathogens which have been extremely successful during centuries, such as Mycobacterium tuberculosis. The majority of the present human population is infected by the tuberculosis bacteria, though most in a lifelong, latent phase with a risk of reactivation to clinical illness. TB alone causes two million fatal cases every year. Currently, there is not any prerequisite of TB being controlled soon on a global scale – not until poverty is eradicated and no disadvantaged population groups remain. On the contrary, there is a resurgence of TB-disease in the world due to the parallel HIV/AIDS pandepidemic causing widespread immunodeficiency facilitating reactivation of latent TB infection. HIV and TB constitute a fatal relation. These two diseases together with malaria are killing six million people in the world every year. Occurrence of multidrug resistance of the TB-bacteria has decreased the possibilities of successful chemotherapy. Should more efficient vaccines and antibiotic products be developed, the TB-bacterium might still escape to reservoirs e g in cattle and wild animals. The TB bacterium is indeed "the mother of all survivors" in the microbial world.

Influenza virus is another survivor, mainly due to the genetic variability and the reservoirs in e g swine and birds which are sources for genetic re-assortment. It is likely that mankind will continue to live under the threat of another appearance of the deadly type of pandemic as the Spanish Flue in 1918.

During the 20th century an extremely successful master survivor has appeared, namely HIV, the AIDS virus. HIV jumped from an endangered species, chimpanzees to human beings around 1930 in West Equatorial Africa. In the human population HIV has found a reliable host and has spread to all countries of the world during a few decades. Its future is secured by being linked to procreation and the promiscuous behaviour of many men. In all likelihood HIV will remain with mankind from now on. So far, 70 million people have been infected worldwide of which 30 million have already died of AIDS. There are five million new cases of HIV infections and three million fatal cases annually. HIV is even more prone to genetic variation than influenza virus causing antigenic shift and resistance to antiretroviral drugs. HIV has another advantage compared to influenza virus; the vertical spread of HIV from mother to child during pregnancy, delivery and breast feeding. And of course, the HIV stays lifelong with the host allowing transmission of the virus for some ten years on an average.

Sexually transmitted infections are particularly difficult to control. Syphilis is still common in the world after more than five hundred years, in spite of the possibilities of an effective and simple cure by penicillin since the 1950s.

In contrast to this series of successful survivors there are some emerging infections which have caused great alarm, for instance certain types of haemorrhagic fevers like Ebola. A high immediate mortality rate is not conducive to further distribution of an infectious agent, it is rather constituting "a dead end" to further spread. It is a wrong strategy to kill the host organism rapidly. Also, transmission of Ebola virus requires close person to person contact. Therefore, outbreaks of Ebola virus are rather self limiting.

I like to finish my intervention by a few comments on lessons learned from the past on how to handle new serious infectious diseases.

- Share information worldwide
- Rapid notification of emerging infectious diseases through clinical awareness, laboratory identifications, global surveillance systems. Development of early warning systems. Collaboration between human and veterinary medicine with integration of human and animal public health
- Solid education of veterinarians, physicians, agronomists and wildlife experts

The most important prerequisite to detect and predict is the curious and educated human mind.

Discussion and questions

Christina Arosenius, General Secretary, Swedish Veterinary Society, Stockholm, Sweden

Because of a shortage of time there was no real general discussion at the end of the day. This is therefore just a brief summary of some questions put to the speakers during the day, and some of the general questions and comments made at the end of the day.

Pasi Penttinen.
Question: Is it possible to make vaccines against the Hendra and Nipah viruses?
Answer: Since they are related to measles and canine distemper it will probably be possible to make vaccines.
Question: Can the infection be spread through meat?
Answer: Yes, but probably not through eating. In Malaysia the persons in charge of slaughtering were infected through aerosols.

Stefan Alenius.
Question: Does our modern way of keeping animals in larger and larger herds constitute a risk factor for new diseases?
Answer: In very large herds it is likely that a virus will be able to increase its virulence by a lot of passages through animals.

Sofia Boquist
Question: How could the virus spread so fast through Asia?
Answer: Probably the virus had already existed for some time in these areas, but exactly how it spread so fast is not known. It is likely that it was either through migrating birds or by animal transports.
Question: Is the reason that mainly young persons died possibly a partial, remaining immunity in older persons?
Answer: Normally there is no cross-immunity, it is related to subtype species. It could, however, possibly be some kind of partial resistance.

Christina Greko
Question: Will resistance against antibiotics remain if the antibiotic is removed and no longer used?
Answer: The capacity to become resistant will remain within the bacteria.
Question: What is the difference between resistance against antibiotics in animal and in hospital environments?
Answer: Animal production has nothing to do with resistance against antibiotics in hospital environments; it is not spread there by the animals. On the contrary humans probably spread resistance to animals. Problems with resistance against antibiotics in the human population are caused by bad hygiene and misuse of antibiotics in human medicine.

Jonathan Epstein
Question: Is there a difference in epidemiology of the Hendravirus in different countries and might this be because there are no pigs in Muslim countries?
Answer: There are pigs also in Muslim countries; there are usually people with other religions who keep pigs. There was probably a spread of the infection directly to humans from the fruit bats in Bangladesh. Bats are very important from the ecological point of view so eradication is out of the question.
Question: Has the Nipah virus been found in Australia?
Answer: It has not yet been found, but the fruit bats are there so it might turn up.

Bengt Larsson och Anders Tegnell
Question: There is an obligation to communicate with the international organisations OIE and WHO, is this working? Are we too slow?
Answer: All such systems depend on how good the instruments are and these are more and more coming into place in Sweden. Sometimes we could even be too quick to report suspicions and thereby cause a stop in the trade. It

has even happened that our laboratories have reported a disease before the country with the outbreak has reported it. For example when we have diagnosed people who have been sick after travelling.

Question: Who is responsible for reporting/surveillance of wildlife?

Answer: This is one of the problems, nobody takes that responsibility. Within EU there are some surveillance programmes such as flu in wild birds, rabies, TSE disease, TB in reindeer (not a wild animal really). This is why cooperation between different countries, and their experts, is crucial for good networking, no one can handle everything.

Patrick Cunningham

Question: Should something be done against the trend toward more intensive farming, are they a higher disease risk? Are smaller farming systems more economic?

Answer: Within EU the really large farms are mainly pigs and poultry and they are well controlled and should not be a higher risk.

Lars Olof Kallings

Question: You predicted eradication of measles and polio. Are you not afraid of possible virus reservoirs for these diseases in animals such as primates? It was believed that canine distemper was under control when the big outbreak in seals occurred.

Answer: You can of course never be sure concerning biological circumstances. Even after eradication the virus will be available in some research laboratories, but it must be under very controlled circumstances. If you stop vaccination you will get a virgin population after some time and that is an obvious risk.

Question: HIV/AIDS has severe impact on living conditions in tropical countries and this is not given enough notice these days. What could be done?

Answer: The Swedish government has appointed an AIDS ambassador and increased its support. Some 20 billion US dollars per year are needed to contain the epidemic and this sum is difficult to find. This could be compared to how much is being spent on the much smaller problem of terrorism! But it is driven by political thinking such as the US contributions. There will for sure be future disaster in many African countries such as Botswana where one third of the population is infected. Good work is being done but it is too late. The famine problem is also worsened by AIDS, women can no longer produce food when they have to take care of the sick at home or are sick themselves.

Question: Which diseases are really serious?

Answer: There are also other areas in public health which are serious. There are a lot of other man made diseases such as the obesities epidemic. Another thing which has not been mentioned today is global warming which is calculated to cause 150 000 deaths per year.

Question: We forget easily. We can still not stop the trade with living animals within Europe, something that caused the spread of FMD in 2001. Why can this not be stopped?

Comment: One suggestion is to tax movement of animals to carry the cost of disease risk. There could also be environmental taxes on transports.

Comment: The cost of disease is sometimes smaller that the results of production and people do not care. You must calculate also all other costs. Why should you eradicate things when you sometimes do not know what is going on and the virus will persist and the challenge will remain.

Comment: Growing cities need more meat and animal production increase in areas with a lot of people. Each member state has possibilities to manoeuvre and also the industry. Welfare questions must also be considered.

Comment: The market is driven by large differences in price for animal products in different countries, this must be considered.

Question: How good is the control along the new eastern borders?

Answer: There is a lot of pressure put on the new member countries. There is extensive education, inspections, follow-up etc. Border posts are established and training programmes for these are planned. There is a lot of discussion on how to handle 25-28 borders in the most efficient way.

Förteckning över tidigare utgivna nummer

År 2003; Årgång 142
Nr 1 Det sydsvenska landskapet, framtidsvisioner och framtidssatsningar SAMT Idéer för framtidens skogslandskap
Nr 2 Viltets positiva värden
Nr 3 Inför toppmötet i Johannesburg
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